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Editorial Notes

A Story of Progress

THE Presidential Address of Mr. H. Singleton to the Manchester District Association of Gas Engineers covered a wide variety of subjects, with special reference to the progress of the Huddersfield Gas Undertaking since 1915, the year in which he was appointed Engineer and General Manager. It was a story of much hard work, good engineering practice, and steady development. The policy of increasing the area to be supplied by the Gas Department has been continuously pursued. Small undertakings have been taken over and arrangements have only recently been made to acquire four more. All the works of these undertakings are to be closed down as manufacturing stations. It is to be noted that in all cases the acquisitions have been and are to be accompanied by substantial reductions in the price of gas in the added areas. The area of supply, with a population of 172,200, is double what it was in 1919. The consumption per consumer, however, has fallen from 27,250 cu.ft. to 24,760 cu.ft., and we suppose that if industrial consumption was taken into account, the fall in respect of the domestic consumer would be shown more steeply.

Mr. Singleton is no doubt right in attributing this fall mainly to the inroads of electricity into the domestic lighting load—helped, of course, by slum clearance. The increased use of the tin opener must also have contributed. He has in operation, however, an attractive scale of tariffs, and with further education of the public on the merits of gas for heating and water heating this should reverse the process. The fields for gas for space heating and water heating are enormous, and as yet they have hardly been touched. The habits of the people are changing. Some of them, such as the increased use of the tin opener, are against greater gas consumption. Looking ahead, however, we think the changed habits will benefit the Gas Industry more than is perhaps generally recognized. The public will in greater measure demand the comfort and convenience which gas can give—and will give provided promotional rates are applied. The public will demand baths; and even to-day a surprisingly large number of homes in this country are without baths.

We have had a good deal to say during recent years of the desirability of removing the organic sulphur compounds from town gas. From the aspect of the maintenance cost of appliances, particularly water heaters, reduction in the sulphur content of the gas supplied would prolong their life and materially increase the period between the need for cleaning. We feel sure that the cost entailed in sulphur reduction would be more than recouped in lower maintenance costs and better all-round service. Mr. Singleton pointed to this in his Address. He was also able to go a step further and describe the plant he has in operation for partial benzole recovery combined with sulphur reduction at his own works. It is a simple plant, and as a result of its operation the sulphur compounds are being reduced from 20 grains to 8 grains.

There are one or two other interesting matters discussed by Mr. Singleton on which we would touch. On salesmanship in the Gas Industry his remarks were full of sound sense. Like ourselves he is all against the "high-pressure" type. To create confidence is of more value than the mere ability to snap up an order. "The confidence of the public," he said, "is something which may take years to cultivate where a forceful sale of an unnecessary appliance may destroy it in a few minutes." The salesman must know his appliances thoroughly and understand what service can be given, and at what cost, by the different types. He must also understand his public and the ability of the consumer to pay for the services which gas can render. A signature on the dotted line is in itself not enough. The appliance signed for may be wholly unsuitable and the signature may have been given without full knowledge of the obligations thereby entailed. It may be a so-called smart deal, but it may also prejudice a would-be satisfied consumer against the undertaking and tend to undermine the Industry's reputation for service.

Then, on the subject of gas lighting, Mr. Singleton suggested that an improvement might be brought about by the District Associations or Commercial Sections if they collected full particulars of successful installations giving costs of installation, mounting heights, lumen output, gas consumption, and so on. Such a collation of information could be put to

much use. But what is most important is that gas undertakings should co-operate with and seek the help of the manufacturers of lighting equipment. As we have said before in these columns, the manufacturers have developed a practical technical service of high standard, and we know that there is no unwillingness to co-operate on their part. The Gas Industry should not lose the valuable opportunity which this technical service presents.

Finally, we would call attention to Mr. Singleton's remarks on coke. In the past coke has been sold as a residual—and often regarded as a very poor one at that! The prospects of the future market will depend on the sale of coke as a heat service, and it *can* be sold as an extremely satisfactory, cheap, and clean heat service.

Competition from Raw Coal

THE Third Annual Conference of the Combustion Appliance Makers Association (Solid Fuel) was exceedingly well organized on lines which have proved successful for some time in the United States of America. The Conference covered two days and 25 Papers were presented for discussion. The future of coal utilization was discussed, producers and distributors of coal, manufacturers and distributors of coal burning appliances, scientists, consulting engineers, and consumers taking part. The discussions maintained a high level of interest, and what appeared to us as a successful feature was their summing up by a *rapporteur*. This crystallized the discussions very effectively. Two of the Papers were concerned with the status of coal utilization engineers, and both emphasized the need for trained specialists to develop the better utilization of coal. It was suggested that the right type of man could only be recruited if a definite professional status were to be established through the medium of an engineering institution. The type of educational facilities required was discussed, and the lack of such facilities contrasted with the well-organized work of the Gas Industry.

As was to be expected, the praises of the raw coal fire were sung lyrically. With wish father to the thought, the Author of one of the Papers, Mr. N. M. Bell, suggested that the coal fire was so much part and parcel of the home life of the average Englishman that it was totally impossible to visualize English homes without it. "The psychological effect of glowing coal and leaping flames," he said, "the health giving properties of the superabundance of short infra-red rays emitted by a coal fire, can never be replaced by any other form of heating. Let our friends of the Gas Industry talk a little less of the disadvantages of the coal fire, and a little more of the comparative advantages of different forms of heating in relation to health, and they will find that both Science and Nature are in favour of the choice of coal. . . . There is nothing that appeals to an Englishman more than lounging in a comfortable armchair in front of a blazing coal fire. . . . The future . . . will have to alter Nature itself for the Englishman to forego that satisfying and healthy habit of relaxing before the open coal fire." Reminiscent, of course, of the quite remarkable eulogy of Dr. Marie Stopes at the National Coal Convention last November, who, it will be recalled, spoke of the magic of coal—the magic of some "subtle, mysterious, vitally important and valuable health giving radiance, not present in the earlier flickering bright flames over black lumps of coal, warming and entertaining though they may be, but which radiates only when the coals are in a ruddy state of incandescence."

Increasing Coke Sales

THIS magic of the coal fire, then, is only to be obtained when the coal has become a smokeless fuel, and it was salutary that at the C.A.M.A. Conference a word should be said for coke, for there is a bright future for this magic solid smokeless fuel, which is responsible for the health giving rays. Mr. W. L. Boon was able to tell the Conference that during the past three years the annual increment to the existing number of coke grates has approached the 100,000 mark. We can look forward to at least such a number being sold in each of many years to come, for there is no sign of saturation in sight. In the South of England the coke grate and the coke boiler are jointly responsible for the sale of about 2,500,000 tons of coke annually, which is some 60% of the total gas coke sold in the area of the London and Counties Coke Association. Six years ago the proportion of gas coke used for domestic purposes in the South of England was 40%. These figures show the trend towards smokelessness and economy, for coke is the most economic fuel on the market. In the "JOURNAL" as long ago as 1931 Mr. A. F. Dufton, the Author of another Paper at the Conference, showed that in an open fire more warmth was obtained from two pounds of coke efficiently burned than from three pounds of coal.

The public demand is for labour-saving and convenience. Admittedly the use of coke demands a certain amount of labour, but it is cheap, clean, and smokeless. Gas is a more refined fuel; it requires no labour at all and it is convenient. There is a great field for both gas and coke, and the tendency is away from the burning of raw coal, however much the coal protagonists may delude themselves. There was a great deal of talk at the Conference about methods of coal delivery and storage. Gas, of course, has the enormous advantage of being a fuel on tap. The consumer has no need to trouble his head about supplies. Gas heat service is unfailing, and it requires no storage, as do coal and coke under present arrangements. The Author of one of the Papers remarked that he saw no reason why the coal supplies for the day should not be left on the doorstep with the milk and in suitable permanent containers which will also serve to take away the ashes. We can see one reason—that of cost. Then the question of coal quality was discussed and it was pointed out by one consumer that he could never be sure of getting the same quality twice. The need for uniform deliveries was stressed—and this is a matter to which the sellers of coke must also pay the strictest attention.

No Defeatist Attitude

THE extent of the area covered by the activities of the British Gas Light Company would suggest the likelihood of some variation in the results as between one controlled works and another in times of peculiar difficulty such as we have been, and are still, passing through; and, as a matter of fact, this was the actual experience during the year 1938. Both intimate knowledge of the Gas Industry and sound business judgment have been drawn upon to the full in the building up of this important organization, wherein, it may be said, "diversity is strength." This latter point was dealt with by Mr. Henry Woodall, the Chairman and Managing Director, in his Address to the proprietors at the annual general meeting, as reported in last week's "JOURNAL." In addition to the abnormal weather conditions which affected all the works, the Company's two principal stations, Hull and

Norwich, had their own special troubles, inasmuch as some of their important industries seem to be passing through a difficult period. But, the Chairman went on to say, "there is another side to the picture in the satisfactory progress generally of our smaller undertakings, whose importance is becoming increasingly felt; and one of the reasons for the Company's strong position is that our interests, although well co-ordinated and controlled, are also well dispersed."

Thus it is that, while the total sales of gas for the year show a small reduction when compared with those for the preceding twelve months (attributable almost entirely to the two largest stations already referred to), there were individual increases, ranging from 11% downwards, at twenty of the Company's undertakings. An additional 2,000 consumers were connected during the year. Over the same period, nearly 16,000 of the new semi-enamelled cookers were put out to prepayment consumers and on simple hire to ordinary consumers—in great measure in place of old black cookers—and some 14,000 pieces of apparatus were sold. The financial policy is sound, and the management of the Company is markedly progressive. The latest example of the Company's enterprise is to be found in an agreement which has been entered into with the Horsham Rural District Council for the purchase of the Council's gas undertaking at Billingshurst, which is in close proximity to the Company's Petworth and Storrington stations. The magnitude of the repairs, renewals, enlargements, and extensions constantly being carried out on the works and on the district is to be gauged from the fact that in the past year five entirely new gasholders were completed, while another is now in hand, and one works has been almost wholly reconstructed. All the Company requires are normal conditions, with a return of public confidence; and in due time these will be with us again. Meanwhile, the possibility of a further ordinary share issue, hinted at by the Chairman, will be noted with interest by many of the stockholders.

Personal

Mr. H. S. CHANTRY, who for the past ten years has been Sales Manager of the Stirling Gas Light Company, has been appointed Sales Superintendent of the Hull Station of the British Gas Light Company.

* * *

Mr. GEORGE TOWNSLEY, Statutory Meter Inspector at Darlington, has been appointed to a similar position at Middlesbrough.

* * *

Mr. A. S. NISBET, Engineer and Manager of the Paisley Corporation Gas Department, is to retire at the end of June, having held the position since 1918. Mr. Nisbet was previously Assistant Manager. All his business life he has been employed with the Gas Department in Paisley. In 1932 Mr. Nisbet was elected President of the North British Association of Gas Managers.

* * *

A presentation was made this week by the Works Staff of the Pudsey Gas Company to Mr. R. O. ROBERTS, F.C.S., Assistant Engineer, who is leaving to take up the position of Engineer and Manager of the Skelmersdale U.D.C. Gas and Water Department. Mr. Roberts was formerly Technical Assistant and Chemist to the Rhyl U.D.C. Gas and Water Department.

* * *

The Directors of the Caledonian Gas Corporation, Ltd., announce that Mr. WALTER MUTER, J.P., has consented to act as a Director of the Corporation.

Mr. Muter has been closely associated with the Gas Industry for several years, being a former Convener of Edinburgh Corporation Gas Committee. In that capacity he represented with conspicuous success Scottish interests on the various National Gas Organizations. He has held the offices of President of the British Commercial Gas Association and Chairman of the Federation of Gas Employers, Scotland, and his experience, especially on the commercial side of the Industry, will be of great value in the new sphere of direct control of a number of gas undertakings in Scotland. The Caledonian Gas Corporation, Ltd., now controls nineteen Subsidiary Companies.

Letter to the Editor

Central Testing Laboratory

SIR,—In the discussion on "Space Heating" at the Joint Gas Conference at Birmingham I notice that a central testing laboratory for the Gas Industry was advocated by Mr. Currier.

I can fully support such a proposal and have for a long time past considered that there would be much advantage to the whole Gas Industry in the setting up of a central laboratory to test and certify the large number of all types of gas appliances prior to these being placed on the market. At present managers of gas undertakings have no means of knowing whether the appliances which are offered them are of proper design and construction for use by the public. In the great majority of cases they have no means of knowing whether the particular appliance would be suitable, as they have neither the requisite facilities, special experience, nor funds to make the necessary experiments and tests.

I can speak from personal experience of the good work done by the Central Testing Laboratory of the American Gas Association, which has now been in operation for many years, during which time it has done admirable work in determining which particular types of gas-using appliances can safely be placed on the market. Their acceptance is shown by the placing of a blue seal on all such appliances as satisfy their examination.

I have made seven trips to the United States, during all of which I travelled extensively and met all classes of people in the American Gas Industry, and I can testify that the work of their central testing laboratory has met with general approval from all sections of the Gas Industry. I visited the laboratory on several occasions and was much impressed by the class of work which they do. Their work has been of great value to the manufacturing firms and has enabled them to make important improvements in design and construction.

I consider that the establishment of such a laboratory in this country is long overdue and I venture to suggest that if properly run it would not be long before its decisions in matters of design and construction would meet with general acceptance.

At the present time any manufacturer can turn out appliances which are quite unsuitable for use by the general public, and this state of affairs can only bring discredit upon the Industry.

A few large gas undertakings and notably the Gas Light and Coke Company with Watson House can deal with this particular matter adequately, but the vast majority of gas undertakings are in a very different position and can only adopt rough and ready methods of testing which are quite inadequate for the purpose in question.

For want of such a central organization the two Holding Companies—namely, the Severn Valley Gas Corporation, Ltd., and Gas Consolidation, Ltd.—with which I am concerned have endeavoured to carry out an examination of gas appliances, reports upon which with recommendations are submitted to all the subsidiary Companies concerned. These efforts, praiseworthy though they be, cannot compare with the work which could and would be done by a central laboratory acting for the whole Gas Industry.

I sincerely hope, Sir, that you will lend the weight of your influence towards the establishment of a central testing laboratory on the general lines of that which has done so much good work in the United States.

Yours, &c.,
G. M. GILL.

15, *Moorgate, London, E.C.*2,
April 4, 1939.

News of the Week

The Output of Gas from the Works of the Lincoln Gas Department for the year ended March 31, 1939, was 834,497,000 cu.ft., an increase of 43,563,000 cu.ft., or 5½%, over the corresponding period last year. In the past ten years the increase has been 316 million cu.ft., or 61%.

Liverpool's New Roman Catholic Cathedral, which is slowly rearing its massive bulk to the sky in Brownlow Hill, is to be heated by gas. In their quarterly bulletin, the Cathedral Committee announce that after considerable discussion they have finally selected gas installation.

A Very Successful Cookery Demonstration was held at the Stockton-on-Tees Gas Showrooms during the week ended March 31. This was given in conjunction with Messrs. R. & A. Main, Ltd., and the Demonstrator was Miss Lina Parkyn. Very good attendances were recorded each day, and considerable interest was created among consumers, resulting in increased business.

The Next Meeting of the Members of the Fuel Luncheon Club will take place at the Connaught Rooms, Great Queen Street, Kingsway, W.C. 2, on Thursday, April 20, at 12.40 for 1.10 p.m., when the after-luncheon Address on "The Placing of Industries in the Special Areas" will be given by the Rt. Hon. Lord Portal, D.S.O., M.V.O., D.L. The Chair will be taken by the President, Sir William J. Larke, K.B.E.

At a Meeting of the Institution of Chemical Engineers to be held in the Rooms of the Geological Society, Burlington House, London, W. 1, on Tuesday, April 18, Mr. E. S. Byng (Vice-Chairman of Standard Telephones and Cables, Ltd.) will present a Paper on "Administrative Training for the Chemical Engineer." All interested in the chemical and gas industries are cordially invited to be present. No tickets will be required.

Agreement Has Now Been Reached between the Johnstone (Renfrewshire) Gas Department and H.M. Office of Works for a supply of gas to the new Royal Ordnance Factory at Bishopton. Approximately four miles of 8 in. and four miles of 6 in. high-pressure main will be required, and the cost of this will be borne by the Factory, and gas will be supplied at the Johnstone Burgh rates. A supply of gas will also be given for the first time to the two villages of Houston and Crosslee, through which the main is to pass.

Sanction Has Been Given by the Minister of Health to the raising of a loan of £85,000 by the Doncaster Gas Committee for the installation of a continuous vertical retort system at the Gas-Works.

An Extension of the Public Lighting Contract with the Deal and Walmer Gas Company for a period of one year, on terms identical with those at present in force, has been decided upon by the Deal Town Council.

Application for Two Special Orders is intended to be made to the Board of Trade by the Portsmouth and Gosport Gas Company. The first of these is sought under Section 1. of the Gas Undertakings Act, 1929, with the object *inter alia* of authorizing the Company to raise additional capital to an amount not exceeding £150,000. The second Order is sought under the Gas Undertakings Acts, 1920 to 1934, and includes among its objects provisions for the extension of existing limits of supply.

A Very Successful Exhibition was held by the Kelty Gas Company, Ltd., from March 28 to 31. Messrs. R. & A. Main, Ltd., collaborated, showing various appliances. There were also stands by Messrs. Milne & Mitchell and Messrs. Falk, Stadelmann, Ltd. Considerable interest was shown, and good business resulted. Every housewife attending was served with tea in a buffet arranged for that purpose. In cookers, water heaters, and boilers there was outstanding results in sales. Demonstrations were conducted twice daily by Miss McKinnon, E.C.D.S. The exhibition was opened by Mr. Izatt, Vice-Chairman of the Company.

An Order for a New Coastal Tanker has been placed by the National Benzole Company. The vessel, which will be engaged in carrying home-produced motor spirit, will have a high-speed for its class and a special feature is to be made of comfortable quarters for the crew. The new ship will be used on the West Coast and will replace the *Ben Robinson* at present in service there. Although not very much larger dimensionally, the new ship will carry an extra 60 tons of cargo. This extra cargo capacity should help considerably in dealing with the increasing demands for home-produced fuel in the areas concerned. The vessel and its equipment will be of British manufacture and material, and the whole of the steel plates and sections are supplied by makers who are members of the National Benzole Company and who help to produce National Benzole motor spirit.

Gas Lighting for Furniture Store

In competition with electricity, the Colchester Gas Company were recently successful in obtaining an order for gas lighting in a local furniture store extension. As our photograph shows, a thoroughly up-to-date and pleasing installation has been put in, the units consisting of five 3-light Falk Stadelmann "Pool-light" fittings.

The Gas Company were also entrusted with the heating of the store. This presented somewhat of a problem, as the maximum height was only 9 ft.—thus precluding the use of high-temperature panel heaters—while the customer was reluctant to have floor radiators. The difficulty was finally overcome by the installation of 15 Cannon "Wallflower" heaters, set at an angle round the walls at a height of 6 ft. 6 in. from the floor.

This installation has been in operation since the beginning of last December, and every satisfaction has been expressed in both its efficiency and appearance.

A Wonderful Record of Safe Driving

Ten years ago Richmonds Gas Stove Company, Ltd. (Radiation Ltd.), Warrington, entered their four transport drivers for the "Safe-Driving" Competition organized by the National "Safety First" Association. Every year each driver has obtained his diploma, and now each of the four drivers has won the Gold Medal for ten years' driving without being involved in any accident for which he was in any way blameworthy, nor convicted under the Road Traffic Act, 1930, for reckless or dangerous driving or driving under the influence of drink. A fifth driver, subsequently engaged, has four consecutive diplomas to his credit.

The drivers of the firm, therefore, have 100% record of safe driving, and it is calculated that their combined travel over the period exceeds 1,300,000 miles.

Athletic and Social

Dover Long Service Presentations.

Three long-service members of the staff of the Dover Gas Company have retired: Messrs. W. A. Buckman (Chief Clerk), P. Burbridge, and F. Epps.

At a meeting of the staff recently the Secretary of the Company (Mr. A. P. Ghent) expressed, on behalf of former colleagues, the hope that they would have long and happy retirements.

INSTITUTION OF GAS ENGINEERS

A SPECIAL General Meeting of The Institution of Gas Engineers was held at Gas Industry House on March 14 for the purpose of presenting and discussing the Paper on the subject of "Deterioration of Coal in Storage" by James Jamieson and W. J. Skilling. extracts from which we gave in the "JOURNAL" on March 1 and a report of the discussion on March 22. The President (Mr. Robert Robertson) was in the chair. The following are written contributions to the Discussion and the Authors' written reply.

Mr. G. E. CURRIER (Bradford) wrote: The results obtained and the conclusions drawn by the Authors confirm the impressions previously held, particularly with reference to the effect of storage on the quality of coke produced. Some of the anomalous results obtained in respect to ash content in coal and gas production serve to stress the difficulty of accurately sampling coal of various sizes. In the large-scale tests it is unfortunate that conditions were not adjusted to produce a gas having the normal Works calorific value, since comparison is rendered more difficult with several variables.

Until 1936 all coals purchased for the Bradford Gas Department were tested in a separate and complete coal testing plant comprizing one bed of horizontal retorts (two tons per day), together with all the auxiliary plant and apparatus. In 1935 it occurred to me that we had over 30,000 tons of South and West Yorkshire Coal in stock which had been stored in the open to an average depth of 10 to 12 ft. since 1927, and I was anxious to know the extent of any deterioration which had taken place. The quantities of the various coals stored in the several stacks were known and proportionate average samples were taken and put through the coal testing plant with the following results:

	1927	1935
1	2	3
Coal Grading, per cent.:		
0 – ¼ in.	15	21
¼–1 in.	55	45
1 –2 in.	14	25
2 –3 in.	7	8
Above 3 in.	9	1
Gas:		
Cu.ft. per ton	11,100	10,750
Calorific value	664	629
Therms per ton (dry coal)	73·38	67·6
Coke:		
Cwt. per ton (dry)	13·77	13·72
Coke Grading, per cent.:		
0 – ¼ in.	4	9
¼–2 in.	15	34
2 –3 in.	47	29
Over 3 in.	31	28
Shatter over 2 in.	54	42
Coal Analysis:		
Ash, per cent.	6·3	9
Volatile matter, per cent.	34·0	31·0
W.D. swelling test	4·5	3·5

These indicate that there was a reduction in gaseous thermal output amounting to 8·45 per cent., and that the coking properties of the coal were considerably affected.

Since these tests were made the old coal testing plant has been abandoned and a new plant installed using two retorts in each of two of the four benches of Woodall-Duckham continuous vertical retorts. The coal tested amounts to ten to twelve tons per day, and can be carbonized in either downwardly-heated or upwardly-heated retorts.

It has always been considered essential for Gas Undertakings to carry a reserve stock of coal for emergency purposes. It is a form of insurance, but its cost is not always fully appreciated. The following is an estimate of the cost of our storing coal over the period of eight years from 1927 to 1935:

Assuming a price of £1 per ton at time of purchase, and no alteration in price during storage:

	d.
Interest on purchase money at 3½ per cent. per annum for eight years	67·2
Depreciation in value—gas and by-products, say 10 per cent.	24·0
Cost of putting in stock, say	9·0
„ „ taking out stock, say	18·0
	118·2
Cost per ton for 8 years' period	9s. 10·2d.
„ „ „ per annum	1s. 2·8d.

The cost of this insurance is shown (from above figures) to be £617 per annum for a stock of 10,000 tons, and these figures do not take into account any charge for the use of the ground for stocking purposes. When an emergency arises, however, the cost is of secondary importance, the Undertaking being only too glad to have a reserve stock with which to maintain the gas supply.

It is generally understood that the deterioration of coal in storage is greatest during the first twelve months, and it would be useful for all Undertakings if the annual depreciation in the value of coal, taking into account gaseous thermal yield and the production and quality of coke and other by-products could be determined for the average coals obtained from the main coal-fields supplying Gas Undertakings. Over a period of years this may indicate a point in the deterioration of coal at which it would pay to carbonize and replace.

Determination of Swelling Power.

Dr. R. A. MOTT (Midland Coke Research Committee) wrote: We have made a number of tests on this problem using the determination of swelling power in the Sheffield Laboratory Coking Test as the index, a value I believe is superior to the caking power for this purpose. I should like to deal with one aspect only of the Authors' results and to draw attention to the fact that moderate storage does not necessarily cause a deterioration of the carbonizing properties of coals when stored in lump form.

The Authors mention, in passing, the slight increases in caking power and calorific value with mild storage but some difficulty in sampling may have obscured what may be a more general relationship. We have previously drawn attention to the fact that strongly swelling coals usually increase in swelling power for some weeks after mining. From a preliminary examination of the Authors' figures I find that for six coals which showed an increase in caking power during storage for 15 months—namely, Bannockburn Main A (15), Bannockburn Main B (16), Kilsyth Coking (14), Shotts Gas (10), Twenty Inch (11), and Diamond (20), there is either an increase in the average size of the coke or no notable change—an observation which for this factor may be extended for much longer periods of storage. For at least three of these coals there is a real (or probable, having regard to the consistency of the analytical data) increase in the calorific value of the dry, ash-free coals, and for at least three no appreciable change or even an increase in the thermal yields of gas. All these coals were originally over

85 per cent. carbon (dry, ash-free basis) and usually of rather high hydrogen content, *i.e.*, about 5·5 per cent. (except Diamond).

We have previously suggested* that coals of over 86 per cent. carbon content (Parr basis) are not liable to deteriorate on storage for periods of 6 months and have shown that Silkstone coal (carbon 85-86, hydrogen 5·7 per cent.) gives a harder coke when coked in coke ovens after 5 months' storage and that storage for this coal as a slack or smalls for 11 months causes no deterioration of coal quality.

It appears to me from the examination I have been able to give of the Authors' figures that a general recommendation might be made that if it should be necessary to store coals for a period of, say, a year it would be advisable to choose those of over 85·5 per cent. carbon content (dry, ash-free) and that such coals might be expected to give little if any deterioration of thermal yields or of coke size after storage for that period. Since coals of 85 to 87 per cent. carbon content and about 5·4 per cent. hydrogen content are the best gas coals, *i.e.*, in giving the highest thermal yields of gas of high calorific value, the use of such coals should make a special appeal to the Gas Industry.

Mr. G. M. GILL (London) wrote: Experience shows that it is decidedly important to store coal which is suitable for storage, and past experience in many cases shows which coals can be stored safely and without undue loss of value. Laboratory experiments will also give reliable data from which at any rate one can determine which coals should not be stored.

The difficulty, however, at the present time is to buy the particular coal which is required for storage Those who are daily engaged in buying coal know quite well that while in theory one should be able to change one's source of supply, in practice it is virtually impossible under the conditions imposed by the Sales Organizations. It is a fact to-day that every possible pressure is brought to bear upon us to continue with the coals which we have been using in the past.

Many Gas Undertakings will therefore be unable to act upon the information so ably set out in this Paper and particularly the smaller ones which only buy one or two classes of coal.

Reactivity of Cokes.

Mr. W. E. RAYBOULD (Tamworth) wrote: It would be interesting to know if any determinations have been made of the reactivities of the various cokes. The question of deterioration upon storage is of importance in the case of free-burning house coals, where the variation in burning characteristics after storage is more marked than would appear to be indicated from considerations of the analytical results alone. In this case the burning characteristics would appear to be closely linked with the reactivity of the semi-coke, a reduction of reactivity giving rise to a slower rate of combustion and an increased yield of cinder. Any further information which the Authors may have regarding the characteristics of the cokes produced after storage would be of interest in correlating the present work with the results obtained upon coals of the non-coking class.

Mr. G. C. PEARSON (Birmingham) wrote: Under the direction of the late Dr. W. B. Davidson about 1908-1910, I carried out some experiments at the Birmingham coal testing plant on the effect of stacking coal. The coal used was principally large Yorkshire, but after twelve months the appearance indicated considerable weathering in that the brightness was lost and laminations more marked. Also the lumps of coal in many cases disintegrated.

These tests were summed up by Dr. Davidson in his Paper before The Institution of Gas Engineers in 1910 in the following sentences:

> "Several valuations have been undertaken of coals that have been stacked and, six months to two years afterwards, picked up. After making allowance for the excess of moisture present in the coal, the gas multiples were in every case slightly lower than the standard. Our tests do not definitely indicate the percentage loss per annum. It would appear to be no more than 2 per cent. It may be mentioned that while the gas value decreased, the yield of liquor increased very appreciably—no doubt the result of the action of water. The coke markedly depreciated."

* Fuel, 1937, 16, 99.

The Authors' Reply.

The AUTHORS, in reply, wrote: We wish to express our thanks and appreciation to those who have contributed to the Discussion on this Paper, particularly in regard to the sympathetic manner in which they have dealt with the many points on which we have found ourselves open to criticism. During the progress of the experimental work we became keenly aware of many variable factors over which we had little control and which necessitated important changes, and these in turn produced difficulties in interpreting the anomalies which kept appearing in the results. Considering the local nature of the coals used and that it was principally in relation to the Gas Industry that the work was undertaken, it has been very gratifying to note the interest which the Paper has evoked in other industries where large quantities of coal are used.

Dr. Smith and Dr. Lessing have referred to the difficulty in reproducing results when dealing with such a heterogeneous material as coal in large-scale plant, and it has been realized that although certain changes were forced upon us while the experiments were in progress others might have been avoided. A very sound suggestion has been made by Mr. Currier on this point, namely, that an attempt should have been made to maintain the declared calorific value in the large-scale retort test rather than to reproduce the conditions prevailing in the original test. This would probably have made clearer the loss in gas yield and therms. The limited quantity of coal available and the difficulty and time required to adjust the working of the plant made this course impracticable, so that it was decided to keep the condition of the test on the weathered coals the same as those adopted for the original test. On the question of uniformity of samples, one would have expected the screened small coals 14, 15, 16, and 17 to have shown some consistency, but they reveal variations of an order similar to the heterogeneous coals of large size.

The question asked by Dr. Smith on the effect of a storage under sea water has been answered by Dr. King in his reference to the experimental work carried out by the U.S. Bureau of Mines, but, in addition to the possible deleterious effect of chlorides absorbed from the salt water, there arises the question of the effect of the water on disintegration of the coal. Dr. Lessing has drawn attention to the effect of oxidation on the mineral partings or ankeritic veins in that they will tend to split open the coals; it would, therefore, appear that the solvent action of the water on these "veins" will result in a similar breaking down of the coal. If, however, the underwater storage retards oxidation and preserves the caking properties of the coals, any disintegration of coals required for carbonizing purposes would be compensated for by the agglutination which would take place during carbonization.

It is interesting to note Dr. Mott's confirmation of the satisfactory behaviour of coals of 85-87 per cent. carbon (dry, ash-free) in retaining their caking properties for a period of a year or so, and also his reference, through Mr. Nicholson, to Silkstone coal.

The Metallurgical Coke Maker.

We agree to some extent with Mr. Curry that the metallurgical coke maker whose ovens are almost invariably situated adjacent to the colliery need not consider the question of storage, nor is it advisable in view of the fact that his principal product is coke and that the most susceptible property of the coal when exposed to weather conditions is the caking property. When, however, coke ovens sell gas to Gas Undertakings, it would seem desirable and reasonable for them to carry stocks to ensure continuity of supply. In view of the importance of the quality of coke produced it would be necessary to arrange for this stock to be turned over continuously. In the case of public utility undertakings stocks are essential owing to their distance in many instances from the coal-fields and to the fact that they must make provision for continuity of supplies, guarding against interruptions due to rail delays or colliery stoppages. The gas

engineer has to select his coal from the point of view of its retaining a certain degree of caking power and that after a reasonable period of storage it will still be capable of producing gas of the declared calorific value without unduly disorganizing his routine conditions of operation. The power engineer, in addition to continuity of supply, must consider degrees of disintegration, retention of caking power, and calorific value.

Mr. Curry and Mr. Hewson have both made references to the use of the 1½ in. screen during the small-scale experiments. The run-of-mine coals received had been passed over a 1½ in. screen at the colliery before loading and, prior to setting them down in storage heaps, material passing a 1½ in. screen was excluded as representing breakage in transport. In order to give some measurement of the degree of disintegration during storage, each portion removed for test was passed over the 1½ in. screen, but all small material passing through this screen was weighed and returned to the sample prior to carbonization. Mr. Currier has produced some interesting figures showing the additional charges which must be faced by those large Undertakings which cannot avoid the necessity of storing coal.

Mr. Gill's reference to the difficulties experienced by Gas Undertakings in liberty of action to purchase coals from any source that the Manager may consider would give him better results is a very real point. In many instances it is not only a question of choice of supply, but also of uniformity in quality, particularly where seams of varying quality are worked at one colliery.

Dr. Holling's observations on the calculated hydrocarbon enrichment values are of considerable interest, and especially his suggestion that the improvement recorded in the figures from the small experimental retorts after the coal had been stored for 45 months is due to the better and more uniform heating of the retorts by the change to the use of gas. In addiuon to this change in the method of heating prior to the testing of the third weathered sample, the quantity of coal used was changed from one-fourth to one-sixth of the heap. This change resulted in an increase in the ratio of large coal to small, and it was to this change that we were inclined to attribute the improvement in enrichment value. As this argument might be discounted by the fact that the small screened coals should not have shown this improvement, but actually did, Dr. Holling's suggestion must be given consideration, and when the remaining portion of the coal is carbonized it is hoped that some light will be thrown on this anomaly.

Loss in C.V.

Mr. Hewson's enquiry as regards the magnitude of the loss in calorific value and to a certain extent Dr. Foxwell's remarks on the same matter have been dealt with by Dr. King in his contribution to the Paper. Experiment has indicated the loss to be comparatively small, depending upon whether or not heating has taken place. However, before Dr. Foxwell's questions can be satisfactorily answered we must know something of the nature of the combination of the oxygen and the coal substance. Probably the work referred to by Dr. King, which is proceeding at the Fuel Research Station, in studying the extent of the minute fissures in the coal mass by utilizing the penetration effect of soluble salts in conjunction with X-ray photography, may ultimately give a clue to the function of the oxygen in bringing about deterioration in certain properties of the coal.

Mr. Raybould has raised the question of "reactivity" of the cokes. At Granton Gas Works there is a tubular firebrick-lined piece of apparatus 3 ft. 2 in. in height and 1 ft. 1 in. in diameter, fitted with firebars at the bottom. Into this is placed 16 lb. of incandescent coke drawn straight from the small experimental retort, the charge being allowed to burn itself out and the residue of unburnt coke and ash weighed. The test, which is rough and ready, is referred to at the Works as the "Chauffer" test. The cokes from each carbonization test in the small retorts were burned in this apparatus, and, considering the crudeness of the test, it is interesting to note that results show little or no change in the quantity of residue from the groups of caking and of cannel coals, but in the case of the low-caking coals four of the six show a definite increase in the unburnt residue.

Reference has been made in the Paper to the quantity of coal which still remains to be tested. This is in excess of one quarter of the amount originally laid down. As the first two tests were carried out each on one quarter, it is considered that the final test should be carried out on the same quantity as the first tests. This is thought advisable, as the anomalous figures from the third weathered sample may have been partly due to the difference in its proportion of large to small coal. This test may assist in clearing up some of the points that are difficult to explain, and suggestions put forward in the Discussion will be carefully considered in connexion with this last experiment of the series. Should the results elucidate any matters worthy of further publication, it is hoped that an opportunity will be given to present these in a supplementary Paper.

Some Technical Problems at Exeter Gas-Works

by F. A. RHEAD,
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Exeter Gaslight and Coke Company.

From a Paper to the Western Junior Gas Association, March 18.

Water.

At Exeter two sources of supply are available—from the City mains or from the City Ship Canal Basin. Many years ago a works well was in use, but after a period proved inadequate to meet the growing demands. Although no records of the hardness of this source of supply are available, it is almost certain that it would be definitely harder than that available from the other sources, and that deepening the well to increase supply would have resulted in a still harder water.

The City supply, like all water supplied by public utility undertakings, suffers from the drawback of high cost, despite certain very definite advantages such as purity, pressure, &c. It is used for laboratory purposes, water flow calorimeters, loading of station governors, and certain domestic purposes, all other requirements being obtained from the City Canal Basin.

The Exeter Gas-Works are situated a short distance below the confluence of the Rivers Creedy and Exe, both of which collect most of their water from Exmoor and its surrounding countryside. They are relatively swift moving streams which in wet weather carry a large amount of suspended matter, both mineral and vegetable, the hardness of the water dropping from the usual 5°-6° to about 2°. A typical analysis of the City Basin water—fed by the River Exe—is as follows:

	Grains/Gallon.
Total hardness	5·25
Temporary hardness	3·85
Permanent hardness	1·40
Calcium carbonate	3·85
Calcium sulphate	1·2
Magnesium sulphate	0·6
Sodium sulphate	0·3
Sodium chloride	2·05
Free CO_2	0·3
Iron as Fe	0·035*
pH value	7·5

* Possibly present as a combination of humic acid.

Use of this water has caused trouble in many directions, particularly with boilers, condensers, and gasholders.

Boilers.

The main steam raising plant consists of two large Lancashire boilers fitted with forced draught breeze burning furnaces and two induced draught waste heat boilers of the usual multi-fire tube type. Originally raw canal water was used in the Lancashire boilers and gave a heavy but somewhat soft deposit of scale containing mud. When the waste heat boilers were installed, a pressure sand filter was fitted to deal with all canal water pumped to the Works. As anticipated, this brought about a material reduction of suspended matter and put a stop to the exploration of adventurous eels, some of which had been found as far afield as the boiler feed pumps. An unexpected result was a definite hardening of the scale, which was less in thickness, in the boilers, presumably due to the removal of colloids. A boiler compound was then used with moderate success for several years.

About twelve months ago the Lancashire boilers were fitted with circulators and Thermofeed control and an increase of 10% in water evaporated per pound of fuel obtained. A few months later, two Filtrator linseed units were installed to treat the main boiler feed water system. These units may be regarded as large steam traps containing baskets of triple screened linseed. The live steam in the trap, at 80 lb. per sq.in. pressure, extracts a colloid from the seed, this being carried by the condensate leaving the trap to the feed water tank, where it is admixed with the feed water leaving the tank. To ensure a continuous supply of colloid the daily re-charging of the units is staggered, being carried out at 5 a.m. and 5 p.m. The water circuit to the boilers has been made a closed one with the overflows from the waste heat boiler feed tanks returning to the main tank. An immediate result of the use of linseed was a distinct odour of linseed in the steam at the end of the range—some 600 ft. from the boilers.

One Lancashire and one waste heat boiler have been opened up since this treatment was adopted. In the case of the Lancashire boiler a great reduction in scale was found, only about one-third of that formerly found being removed on scaling, and it was also very much easier to remove. At the main flue end of the boiler no scale or mud was found above the water line where previously the gusset plates had been hidden by accumulations after four months' working. A similar improvement was found in the condition of the waste heat boiler, the only mud in the boiler being a few small lumps adhering to the underside of the feed water trough. Scale on the tubes was nowhere thicker than 1/32 in. and was easily removable by rubbing or scraping, chipping not being necessary. It also appeared that colloid was loosening old scale in the inaccessible parts of the boiler at the junction of tubes and tube plate on the inlet waste gas end.

Longer Working Hours.

In addition to the saving on labour in scaling, allowance must be made for the longer working hours obtained in the case of the waste heat boiler and the increase in efficiency gained by greater heat transmission through the fire tubes owing to the thinner deposit of scale.

The Filtrator continuous blow down system has been fitted to the two waste heat boilers. Corrosion resisting orifices of a self-cleaning and easily accessible type are fitted to tees on the live side of the main blow-down valves, which are kept closed. Water and sludge are continuously discharged into a steel cylinder common to both boilers, in which, owing to the reduction of pressure to 1-2 lb. per sq.in., large volumes of steam are released and led back to the feed water tank via a non-return valve. Three liquid discharges from the tank are provided, two of which are constantly operating, the third and lowest being a sludge cock used once per shift only. The upper one of the two continuously discharging returns clear water, from which sludge has settled to the feed water tank, while the lower one passes to waste a small quantity of water via a closed coil in the feed water tank. This latter discharge enables the concentration of salts to be kept within safe limits with the minimum heat loss, a valuable feature and peculiar to the Filtrator system. The upper limits for salt concentration, in terms of sodium chloride, worked to are: Lancashire boilers, 500 grains per gallon; waste heat boilers, 300 grains per gallon.

Condensers.

Considerable trouble has been experienced with horizontal water tube condensers due to corrosion of water tubes and tube plates. It must be pointed out that this is entirely due to the peculiarities of the water, and is in no way attributable to the design of the condensers. A red rusty deposit forms on the iron surfaces in contact with water, together with large blisters of rust, which when opened reveal dark patches of iron oxide. As this trouble was undoubtedly due to oxygen, either dissolved or entrained as air, the condenser feed and main water pumps were carefully examined and any faulty glands on the water side made good.

The water sides of the condensers are thoroughly cleaned annually, and although the plant is only a few years old, many tubes have been replaced. All tubes are now having their water surfaces coated with a special bitumastic paint, and any damage caused by the expanders touched up, and the tube and cover plates similarly coated. It is too early to give any estimate of the effect of this treatment.

Gasholders.

During the early autumn of 1937, the presence of sulphuretted hydrogen in the City gas was revealed by the 24-hour laboratory tests, the quantity, however, being far less than that revealed by the Gas Referees' sulphuretted hydrogen test. Similar tests at the outlet of the station meters showed no trace at that point, and as there was no interconnection of foul and clean gas mains it was obvious that sulphuretted hydrogen was being formed in the holders, and further tests showed that all holders were affected in varying degree. It has been shown that bacteria can be responsible for the production of sulphuretted hydrogen under certain conditions in gas holders by reducing sulphates in the water.[1]

The three holders Nos. 1, 2, and 3 are of 500,000, 750,000, and 2 million cu.ft. capacity respectively. No. 1 was slightly, No. 2 very badly, and No. 3 very slightly contaminated. In autumn, owing to the fall of atmospheric temperature, the upper layer of water in the holder tanks becomes cooler than that at the bottom, and hence more dense, resulting in the setting up of circulation, thereby maintaining a continuous supply of water for the use of the bacteria. It has been established that the bacteria require sulphates for their existence, so the quantity of these in the holders was determined. In the case of the worst holder, this was found to be in the order of one grain per gallon. No. 3 holder, which had not received any make up water other than rain since being put into commission in 1931, had less sulphate content, while No. 1 holder, which has an annular tank of unusual design, had received a small amount of make up water continuously, maintaining the sulphate content.

The steps taken differed for each holder. As the sulphate content of the large holder (No. 3) and the contamination were both low, it was assumed that the trouble would soon disappear and this proved to be the case. The gas from this holder was backed into No. 1 holder before delivery to the City, thus purging it, and as the addition of water to the tank was discontinued the sulphate content of the water disappeared and concurrent with this so did the sulphuretted hydrogen. No further trouble was experienced in the corresponding period of 1938 with these holders.

As the case of No. 2 holder was far more serious, the holder was put out of commission for about 10 weeks, being deflated until only one plate of gas was left in the bell. By the use of a steam-operated ejector, water was taken from the inside of the bell at a point about 12 in. below the surface, discharged about 8 ft. above the centre of the crown, returning to the tank via the crown sheeting, over which it spread in a very thin layer, wetting the whole of the surface. The water when discharged was warm, but owing to the large surface exposed was quite cool before re-entering the tank.

[1] H. Hollings and W. K. Hutchison. "Gas Purification." "Gas Journal," No. 3,765, p. 156.

It was calculated that the quantity of water circulated was slightly over twice that contained in the tank. By the addition of this method it was hoped that any sulphuretted hydrogen dissolved in the water would be driven off and also that the circulation would simulate that caused by the autumn fall of temperature, thus allowing the bacteria to remove the sulphate in the water.

After eight weeks the sulphuretted hydrogen content of the gas in the bell was found to be *nil*, and the sulphate content of the water to be negligible. The water was circulated for a fortnight longer, after which the holder was put into commission, since when no further trouble has been experienced.

Crude Benzole Recovery.

At the present time great interest is being shown in crude benzole revovery, and it was felt that some remarks about the recently installed plant at Exeter might be of interest.

Working on the wash oil system, the plant is designed to recover crude benzole at the rate of two gallons of 65's per ton of coal carbonized from 4 million cu.ft. of 475 B.Th.U. purified gas per day. The coal used is, with the exception of a small amount from Nottinghamshire, from the Yorkshire and Durham coalfields.

The washer, of Messrs. W. C. Holmes standard 6-bay multi-film (static) type, has given very effective stripping with reduced oil circulation both in individual bays and through the washer.

It has been stated recently[2] that figures for steam consumption per gallon of crude benzole produced vary between 11·7 and 77 lb. on different installations and that a fair average would probably be 60 lb. It is realized that steam consumption plays a large part in the economics of benzole recovery, and in consequence the designers were asked to pay special attention to this important factor. The Chemical Engineering and Wilton's Patent Furnace Company, whose recovery unit was installed, guaranteed the low figure of 37 lb. per gallon of 65's crude benzole. This figure proved to be in excess of that obtained in practice, a six-hour test made at 50% of the rated gas throughput giving a figure of less than 31 lb. steam per gallon of 78's benzole. Experience has shown that for equal volumes of gas stripped the amount of steam used in the plant in unit time is constant irrespective of quality of benzole produced. From the makes of benzole of different qualities it has been calculated that for 65's benzole only about 24 lb. of steam per hour would be required. Further, it is anticipated that when stripping the full quantity of 4 million cu.ft. of gas per day this amount will be again reduced, as very little extra steam will be required for complete stripping.

Low Steam Consumption.

The low steam consumption has been obtained in three ways—by efficient heat interchange, by efficient heat insulation, and by ensuring that the latent heat of all steam entering the plant is fully utilized.

Heat Exchange.—In addition to the usual oil/oil heat interchanger, which in this case has been arranged as duplicate vessels in parallel, the cold oil from the benzolized oil tank passes, after metering, through a vapour/oil heat interchanger, being used to condense the larger portion of the vapour leaving the fractionating column. The heat so recovered is over one-third of that entering the plant. In addition to the saving of steam so effected, there is the additional saving of water to the final vapour condenser.

Heat Insulation.—All vessels of the plant are entirely encased in 2 in. of 85% magnesia and hard-setting compounds, covered with canvas, sealed, and painted. All pipes carrying warm oil are covered with glass silk and bitumen sheeting.

Latent Heat.—In addition to the recovery of the latent heat of benzole vapours and steam in the vapour/oil heat interchanger which has been already mentioned, the plant is so arranged that all the exhaust steam from the engine driving the oil-circulating pumps can be used on the stripping still in place of live steam. No live steam is found necessary at present, the exhaust steam supplying all the necessary heat required for stripping. The pump engine is designed to work against an exhaust back pressure of 15 lb. per sq.in., but in practice only 2 lb. is found necessary. All the exhaust steam passes to the still via an oil separator. No waste steam can be seen issuing from any point on the plant, practically all being condensed to water and its latent heat utilized.

[2] W. Nicol Baird. "GAS JOURNAL," No. 3,950, p. 301.

Discussion.

The **President** (Mr. A. Tran, Reading) said it would be interesting to know what the result of treating the condenser tubes would be. He was interested in the discoloration of holder bells; the solution of this problem was very elusive. In connexion with benzole, he was very interested in the steam consumption figures, as they had such an important bearing on the cost of production.

Mr. H. H. Brown (Engineer and Manager, Exeter Gaslight Company) remarked on the fact that a good deal of work in this Paper had been done by Mr. Rhead in his own time, and paid special tribute to the ingenuity which the Author had displayed in preparing the heat-flow diagram for the benzole plant. With regard to the gasholder tests he said that they were fortunate at Exeter in being able to put the holder out of action for six months without any inconvenience.

Mr. S. Smith (Bristol) thought there might be a danger of linseed oil causing trouble in the boilers with the filtrator system, and enquired how much water was "blown down." With regard to discoloration of holder bells milk of lime had been tried at Bristol with only partial success; the trouble appeared to be caused by exchange of metal between the tank and the bell. When trouble with H_2S in holders had been experienced at Bristol, it had been cured by the addition of zinc oxide or zinc acetate to the water.

Mr. Rhead said the linseed was carefully screened before use, and no trouble arose from oil. He could not put a figure to the amount of blow-down, but it was very small indeed. He confirmed Mr. Smith's experience with milk of lime in holder tanks; he also had found only temporary benefit. It had not been necessary to resort to zinc oxide treatment for H_2S at Exeter.

Mr. K. L. Clark (Weston-super-Mare) said the filtrator system had been used for a number of years at Weston, having been installed originally to deal with salt water. He enquired how much linseed was used at Exeter per 1,000 gallons of water evaporated. He suggested the Author was wrong in claiming that the filtrator was the only system in which the blow-down went back to the system; other firms had used this method for years. On the matter of bacterial production of H_2S, he said Mr. Rhead appeared to have set out to prove it was bacterial action, and had done so. While he did not say the Author's proof was not conclusive, he drew attention to the fact that this impurity was produced by the slow reaction of small traces of ammonia with carbon disulphide. In connexion with oxygen to purifiers, it had been proved that the amount required for revivification was equal to the volume of impurity removed generally, and he presumed the remainder above 0·4% was drawn in from some other place.

Mr. Rhead said the linseed used was 1½ lb. per 1,000 gallons of water; he had not been aware of other water treating firms using a continuous blow-down into the system. The reduced oil circulation referred to was reduced from 800 gallons per hour to 400, just at present. He had not considered the reaction referred to as producing H_2S, but thought his proof established bacterial action. Regarding the air to purifiers, he thought it possible that the meter used was a bit slow in registration.

Mr. R. C. Beake (Bath) said he did not see how filming the water with oil would stop the action of water on the plates and tank, as there would always be dissolved oxygen. He asked for the steam pressures and temperatures at the benzole plant.

Mr. Rhead said that except for rainy periods the solution of oxygen in water would be stopped. The steam pressure was 80 lb./sq.in., and having just passed a reducing valve it could be taken as dry; it might even have a slight superheat.

Mr. J. W. Denton (Torquay) said it appeared that, in filtering the water, colloids were removed, and later with the filtrator colloids were put back. He asked how much water was lost in back-washing the filters, and thought that with the continuous blow-down it would be better to have a test that the boiler attendant could carry out.

Mr. Rhead said that in filtering, more than colloids were removed, and with the treating system only colloids were put back. The loss of water in back-washing was quite small compared with the volume treated. He did not agree with Mr. Denton about the testing. The job was done by the technical staff each day, and did not take very long.

Mr. R. J. Rew (Messrs. Willey & Co.) congratulated the Author on his Paper, and a formal vote of thanks was proposed by **Mr. T. W. Clapham** (Bristol), supported by **Mr. J. W. Denton** (Torquay).

Air Raid Precautions

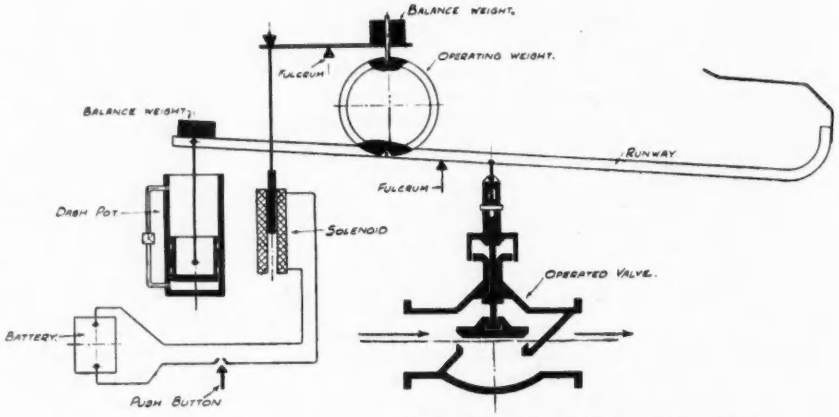
By H. Bott, A.M.I.Struct.E.

To isolate a gas, steam, or fluid main in a case of emergency from a distant point is the subject of a recent invention, the object of which is to provide a valve arrangement which operates easily and has few parts likely to get out of order, and in which the friction of the control gear and the valve mechanism is so small that very little power is required to close the valve.

The valve is set to be held in an open position by a weight which is retained on the upper end of an inclined runway in the form of a lever fulcrummed and coupled to the valve as indicated on the drawing, and in an emergency the weight can be released by remote control mechanism so that it runs under the action of gravity down the inclined lever and moves the valve to closed position. The remote control arrangement for releasing the weight is preferably electrically operated, and a controllable dashpot may be provided to prevent violent movement of the lever and valve.

The weight when in the retained position is prevented from sliding along the runway by a small bar thereon engaging in a V-shaped notch in the weight and the latter is normally prevented from rolling down the runway by a retaining pin or trip rod which projects downwardly from one end of a releasing lever located above the weight. This lever is weighted above the trip rod to hold the latter in a socket in the rolling weight and the other end of the release lever is connected to an armature which can be pulled down by energization of a solenoid to lift the trip rod clear of the rolling weight and allow the latter to roll down the lever runway. The upper end of the lever runway has a balance weight attached to it and is connected to a dashpot which prevents violent movement of the valve, and the damping effect of the dashpot can be suitably controlled, for example, by a regulating cock in a pipe connecting the ends of the dashpot cylinder.

In order to reduce friction to a minimum the usual packing gland for the valve spindle is omitted and leakage is prevented by top and bottom guide seating discs which can bear on suitable surfaces on the valve body when the valve is in a closed or open position.



Explanatory Diagram of Emergency Valve.

The valve can be quickly closed by simply pressing a push button to complete the electrical trip circuit which releases the movable weight and allows it to run down its runway to overbalance the lever and close the valve.

The lower end of the inclined lever runway is bent up and provided with a retaining extension or spring which prevents the weight from leaving the runway guide.

Forthcoming Engagements

April.

14.—North British Association.—Spring Meeting at Leven.

15.—London and Southern Juniors.—Visit to Nine Elms Gas-Works.

17.—G.C.P.A.—Committee Meeting, 2.30 p.m.

19.—National Gas Organizations in Scotland.—Annual Meeting of Federation of Gas Employers, 11.30 a.m.; Annual Meeting of National Gas Council, 2.30 p.m. Both meetings at Central Station Hotel, Glasgow.

20.—Southern Association (Western District).—Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.

22.—Western Juniors.—Annual General Meeting at Bristol.

22-25.—B.C.G.A.—Annual Conference at Brighton.

26.—I.G.E.—Domestic Heating Committee, 2.30 p.m.

26.—Southern Association (Eastern District).—Meeting at Gas Industry House, 2.30 p.m. Discussion on "Breeze Production and Disposal."

27.—I.G.E.—Gas Education Executive Committee, 11 a.m.; Gas Education Committee, 2.30 p.m.

28.—I.G.E.—Specifications Sub-Committee of the Refractory Materials Joint Committee, 2.30 p.m.

29.—I.G.E.—Written Examinations in Gas Engineering (Manufacture).

29.—Midland Juniors.—Visit to Coventry Works of Geo. Wilson Gas Meters, Ltd., and to Foleshill Gas-Works.

May.

1.—I.G.E.—Research Executive Committee, 2.30 p.m.

2.—I.G.E.—Finance Committee, 9.30 a.m.; Membership Committee, 10 a.m.; General Purposes Committee, 11 a.m.; Council, 2.30 p.m.

5.—North of England Association.—Annual Meeting at Newcastle.

6.—I.G.E.—Written Examinations in Gas Engineering (Supply).

6.—Manchester and District Juniors.—Visit to Higginshaw Gas-Works, Oldham. Paper by F. Cartledge on "Coal and Coke Handling Plant at Higginshaw."

9.—London and Southern Juniors.—Annual Business Meeting.

10.—S.B.G.I.—Council Meeting, 56, Victoria Street, S.W. 1, 11.30 a.m.; Annual Meeting in the afternoon at the May Fair Hotel.

11.—Midland Juniors.—Annual General Meeting. Address by G. Dixon (Nottingham).

13.—Scottish Eastern Juniors.—Annual General Meeting at Edinburgh. Presidential Address of R. Cowie, Jnr. (Hawick).

13.—Yorkshire Juniors.—Meeting at Harrogate. Short Papers by D. C. Gunn, J. W. Stacey, and H. Ramsden.

16.—I.G.E.—Gas Education Executive Committee, 2.30 p.m.

18.—I.G.E.—Joint Committee on Complete Gasification under Pressure, 16, Old Queen Street, S.W. 1.

19.—Southern Association.—Meeting at Devonport.

25.—Wales and Monmouthshire Association.—Annual Meeting at Newport.

25-26.—Eastern Counties Association.—Spring Meeting at Grimsby.

June.

6.—I.G.E.—Council, Institution of Civil Engineers, 9.30 a.m.

6, 7, 8, and 9.—I.G.E.—Seventy-Sixth Annual General Meeting, Institution of Civil Engineers.

24.—London and Southern Juniors.—Summer Visit to Windsor.

STRUCTURAL PRINCIPLES IN

The Design of a Waterless Gasholder

by F. N. TIDBALL

(Chief Draughtsman, City of Coventry Gas Department).

A Paper to the Midland Junior Gas Association on March 2.

The holder to which the following particulars refer is the 5 million cu.ft. holder at Coventry. Brief particulars of its construction are as follows:

It is polygonal in plan having 24 sides with a stanchion at each corner. These stanchions are about 23 ft. apart. The diameter across the corners of polygon is 176 ft., area of polygon 2,700 sq.yds., or more than half an acre. Height to eaves of roof 232 ft., height to apex of roof ventilator 257 ft. Stroke of piston 209 ft. There are 83 tiers of side plates, 32 in. deep, 4½ mm. thick. Outside staircase of 400 steps, outside electric lift, internal collapsible staircase for access to piston. Present working pressure 10 in. w.g., the holder is designed for 12 in. w.g. which may be obtained by adding further concrete weights to the piston. Weight of piston steelwork 215 tons. Weight of concrete on piston 400 tons. The 24 stanchions are 9 in. by 4 in. by 21 lb. R.S.J., four ¼ in. web flats, 8 in. by ¾ in. roller guide flat.

A Paper dealing with the design of such a structure as a waterless gasholder would not be complete without some reference to wind pressures generally, as naturally one of the main forces to be contended with is due to the pressure of the winds. In connexion with this subject I would like to refer you to an article on wind pressures published in the "GAS JOURNAL" on Oct. 12, 1932, by a member of the Institution of Structural Engineers, Mr. S. M. Milbourne.

This article may be useful to those of us who do not readily accept wind pressure formulæ, and in particular the method of computing the overturning moment and moment of resistance to wind adopted later in this Paper. In this country we are fortunate in that we do not experience the violent tornadoes that prevail abroad; nevertheless when designing a large structure it is imperative to assume a high figure for wind pressure, so that a good factor of safety is ensured.

In the case of the waterless gasholder at Coventry 50 lb. per sq.ft. is the adopted figure; this corresponds to a velocity of well over 100 miles per hour, and would be classed as a violent tornado. It is very doubtful whether even in a 100 m.p.h. gale that the mean pressure exerted upon the exposed surface of a waterless holder would amount to more than 25 lb. per sq.ft. High wind pressures (not velocity) have only been recorded on small wind gauges in the open, larger boards 20 ft. by 15 ft. situated alongside the smaller ones recording only 66% of the unit pressure recorded on the smaller instrument. Therefore, from the foregoing it is obvious that in a large structure designed to withstand a wind pressure of 50 lb. per sq.ft., and adopting a working stress of 7½ tons per sq.in. of the steel, the actual factor of safety is very high. It will be shown that in the design of the side plates, wind pressure takes no part, as the internal pressure of the gas is the higher figure.

Shell Construction—General Description.

The stiff design of the roof and the method of attaching the roof girders to the vertical stanchions, together with horizontal bracings at roof level enable us to consider the structure as a rigid prismatic one closed at top and bottom. The wind or gas pressure (whichever is the larger) is transmitted by the shell plates to the horizontal ribs formed by the turned-up edges of these plates, and from these ribs to the rigid corners of the prismatic shell.

Shell Plates.—The shell plates are loaded by either: External wind pressure, 50 lb. per sq.ft. = 244 kgs. per sq. metre or internal gas pressure 12 in. w.g. = 302 kgs. per sq. metre. Due to their construction the plates may be considered as being rigidly clamped on all four sides. What is known as "plate action" is neglected, only a vertical strip between two ribs and 1 c.m. wide is considered, the distance between these ribs is 32 in. = 81 c.m. (See diagram A.)

$\therefore$ Load on strip 1 c.m. wide = $0{\cdot}01 \times 0{\cdot}81 \times 302 = 2{\cdot}44$ kgs.

Bending moment = BM = $\frac{WL}{12} = \frac{2{\cdot}44 \times 81}{12} = 16{\cdot}5$ kgs. c.m.

Section modulus of strip 4·5 m.m. thick × 1 c.m. wide to resist this bending moment = $Z = \frac{BD^2}{6} = \frac{1 \times 0{\cdot}45^2}{6} = 0{\cdot}03375$ c.m.^{3}

Fibre stress of strip = $f = \frac{BM}{Z} = \frac{16{\cdot}5}{0{\cdot}03375} = 489$ kgs. per sq.c.m.

This is equivalent to a factor of safety of 9 on 28/33 ton steel (28 tons per sq.in. = 4,410 kgs. per sq. c.m.).

Horizontal Ribs.—Load on one rib = area supported by rib × unit load = ·81 m. × 7 m. × 302 kgs. = 1,712 kgs. The joints between the ribs and the stanchions are covered by butt straps and designed in such manner that they may be considered as girders rigidly clamped at both ends, therefore the maximum bending moment

$$= BM = \frac{WL}{12} = \frac{1{,}712 \text{ kgs.} \times 7 \text{ m.}}{12} = 99{,}875 \text{ kg. c.m.}$$

For the section modulus of the rib a portion of the shell of double the width of the rib is considered. See diagram B. The sectional area of this rib (or girder) is 34·31 sq. c.m. The centre of gravity is found by taking moments of each element of area, and in this case is 16·44 c.m. from the edge.

From this information the moment of inertia can be calculated = I = 1,971 c.m.^{4}

The section modulus = Z can now be obtained

$$= Z = \frac{I}{S} = \frac{1{,}971}{16{\cdot}44} = 119{\cdot}9 \text{ c.m.}^3$$

The maximum fibre stress of rib = $f = \frac{BM}{Z} = \frac{99{,}875}{119{\cdot}9} = 833$ kgs. sq.c.m. = a factor of safety of 5·2 on 28 tons steel.

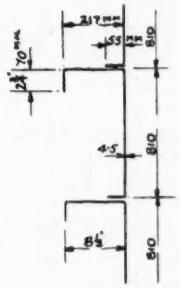


Diagram A.

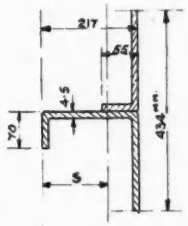


Diagram B.

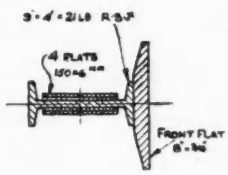


Diagram D.

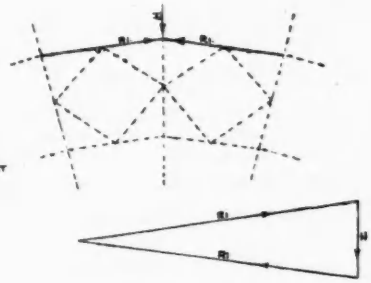


Diagram H.

Shell Posts or Stanchions.—The stanchions are loaded by:

Roof structure = area of roof × 80 kgs. sq m. = 199,750 kgs.
Shell plates = area of plates × unit weight = 24 sides × 7 m wide × 71·8 m. high × 65 kgs. per sq.m. = 786,000 kgs.
Snow on roof (75 kgs. sq c.m or 15·3 lb. sq ft.).. 167,500 kgs.
Snow on gangways (,, ,, ,, ,,).. 63,000 kgs.

Total snow load .. .. 230,500 kgs.

Wind load on shell = area presented to wind × 244 kgs. per sq.m. (50 lb. per sq.ft.) = A = 535,560
Wind load on roof, ditto = B = 3,900
Moment by wind = A × ½ height + B × height (see Diagram C) = 535,560 × 71·8 × ½ + 3,900 × 71·8.. .. .. = 195 × 10^7 kg. c.m.

The sectional area of the stanchions supporting the above loads is 108·17 sq. c.m. (See diagram D.)

Snow is not considered to help anchorage as it is not always present. Therefore the tensile force in each stanchion = area of stanchion × (wind-shell-roof) = 108·17 (560·5 − 302·8 − 76·9) = 108·17 × 180·8 = 19,600 kgs.

This force is upward, so each stanchion must be anchored. Anchors or foundation bolts are nearly always used in pairs, and seldom are ever seen again, so it is usual to err on the side of extra large bolts.

The corrosion factor thus looks after itself. In this case 3 in. diameter bolts were chosen giving a net diameter of 2¾ in. at the bottom of the thread.

Net area of bolts = 2 × 30·19 sq.c.m. = 60·38 sq.c.m.

The tensile stress in the bolts = $\frac{\text{load}}{\text{area}} = \frac{19,600}{60·38} = 324·6$ kgs. per sq.c.m.

Factor of safety = 13·3.

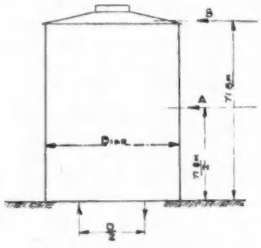


Diagram C.

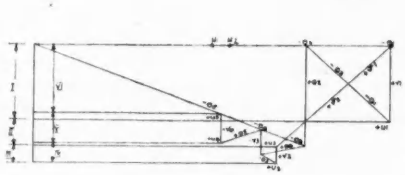


Diagram G.
Force diagram, piston in operation.

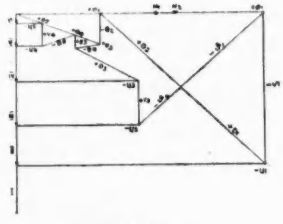


Diagram F.
Force diagram, piston resting.

Area of 24 stanchions = 2,596 sq.c.m.
The moment of resistance of the stanchions = No. of stanchions × area each × moment arm = 12 × 108·17 × 2,681 c m. (½ dia. of holder) = 348 × 10^5c m.^{3}.

From the foregoing the stresses in the stanchions can be deduced:

By roof structure = $\frac{\text{Load}}{\text{Area}} = \frac{199,750}{2,596}$ = 76·9 kgs sq.c.m.
,, shell plates = $\frac{\text{Load}}{\text{Area}} = \frac{786,000}{2,596}$ = 302·8 ,, ,, ,,
,, snow = $\frac{\text{Load}}{\text{Area}} = \frac{230,500}{2,596}$ = 88·8 ,, ,, ,,
,, wind = $\frac{\text{wind moment}}{\text{moment of resistance}} = \frac{195 \times 10^7}{348 \times 10^5} = 560·5$,, ,, ,,

Total stress .. .. .. 1,029 kgs.sq.c.m.
∴ Factor of safety of stanchions = 4·29.

The above figures apply to the stanchions at the base where the wind moment is greatest. The rib plates of the stanchions are reduced towards the top as the wind moment decreases.

Anchorage to Prevent Overturning.

The external forces acting on the holder are:

(1) Upward due to wind moment (upward one side only).
(2) Downward due to weight of holder. (See diagram C.)

If the wind moment sets up a larger overturning force than the weight of the holder will counterbalance, then anchorage must be supplied.

We know that stress per sq. c.m. in the stanchions is

By wind .. .. 560·5
,, weight of shell .. .. 302·8
,, ,, ,, roof .. .. 76·9

We now come to the design of the piston which is by far the most interesting from a structural point of view. It is to be noted that theoretically a flat plate of sufficient weight to give the desired gas pressure is all that is necessary, provided that it is gas-tight at the edges. Practical considerations demand that the piston shall not tilt due to friction, which no doubt a thin plate would. This object is achieved in a very efficient manner in the design under consideration.

It is also desirable that when the piston is grounded that it shall be supported only at its periphery. Looking at the section of the piston on diagram E it will be noticed that it is made up of three parts—*i.e.*, two cantilever girders and a central simple beam or girder. To the underside of these girders and beam is fixed the gas-tight piston deck sheets. The sheets have their edges turned up to form the subsidiary girders which transmit the forces due to gas pressure and/or concrete weights to the main girders in much the same manner that roof purlins transmit the load to the rafters in a house. The sizes of the subsidiary girders or purlins are deduced in the same way as described for the side sheeting, and need not be repeated here.

In designing the piston the conditions are two-fold.

Case 1. Piston resting on bottom.
Case 2. Piston in operation, floating on the gas.

In Case 1 the piston rests at 24 corners on the bottom of the holder, carrying its own, as well as that of the concrete, weight used to give the piston sufficient weight to "throw" the desired pressure. In Case 2 the piston is supported by the gas reacting against the weight of the piston with a pressure of 355 kgs. per sq. metre, this will give a pressure of

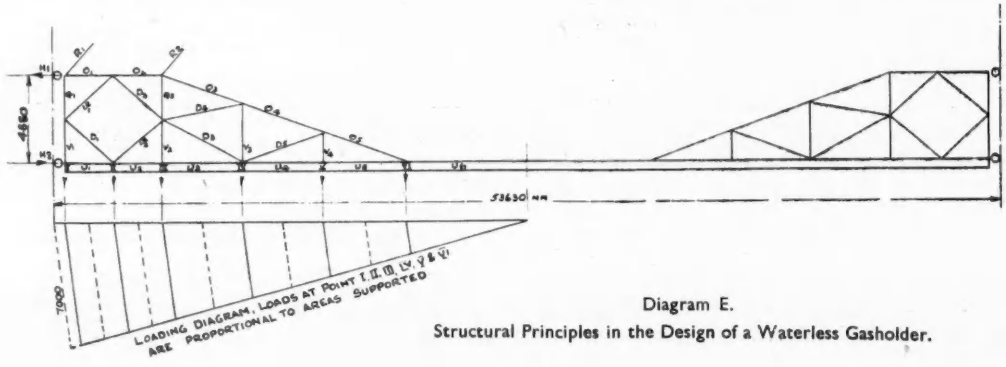


Diagram E.
Structural Principles in the Design of a Waterless Gasholder.

12 in. water column at the outlet pipe. The piston structure consist of 24 radial girders, each girder terminating at a stanchion position, and all 24 being connected at the centre.

For initial purposes of design for Case 1 it is assumed that the cantilever portion is a true cantilever supported by the force couple H_1 and H_2 and loaded at the points of inflection I., II., III., iV., V., and VI. by the loads transmitted from the weight of the piston and the concrete weights. The loads are calculated ones, and are in direct proportion to the area of piston supported, larger nearer the periphery, as the area is larger.

To determine the stresses in the bracings it is first of all necessary to determine the reactions H_1 and H_2. This is done by taking moments about point VI., this will give the magnitude of the forces and will also confirm the direction of the forces by the index sign. The positive index shows that the horizontal force is in the assumed direction. We now have the magnitude and direction of all the external forces on the cantilever, and from this the stress diagram is quite easily prepared. (See diagram F.)

For Case 2, piston in operation, the gas pressure reacts against the ascertained dead loads (ascertained in Case 1), the pressure being gaseous is equally distributed over the area of the piston. From this equally distributed pressure the point loads are calculated. The horizontal force H (reaction) is obtained by taking moments about VI. as for Case 1. The negative index indicates that the horizontal force is opposite to that in Case 1. We can now draw the stress diagram for Case 2, piston in operation. (See diagram G.)

From these two stress diagrams suitable steel sections can be chosen to fabricate the piston in the usual manner—*i.e.*, the forces are measured off the diagrams, tension members being designed to the simple $\frac{\text{Load}}{\text{Area}}$ calculation, area, of course, being taken where rivet holes occur, while compression members being calculated from a known strut formula such as Moncrieff's or Euler's.

We have up to now assumed that forces H_1 and H_2 react against, or are anchored to, the stanchions. This is only an assumption used during design, there is no actual pressure exerted against or from these stanchions, so we now have to resolve these two forces into two other forces that are independent of the stanchions. They are, therefore, resolved in forces Rl and Rl, two equal forces. (See diagram H.) If every girder is treated in the same manner these forces Rl become a complete ring (or more truly a 24-sided polygon) and are all in equilibrium, there being no external force acting on the shell or stanchions. The 24 cantilever girders now form one completely independent braced structure, and only needs to be connected across the centre portion by the 24 simple beams or girders, all meeting in a central joint. To the underside is fixed the piston sheets as mentioned previously.

The Roof Principles.—For the calculation of the roof principles the following loading was adopted:

1. Wind pressure, 50 lb. per sq.ft.
2. Full snow load, 15·3 lb. per sq.ft. = 75 kgs, sq.metre.
3. Snow load on one side only, 8·2 lb. per sq.ft. = 40 kgs. sq.metre.
4. Weight of principles, covering, &c., 80 kgs. sq.metre.

In such a truss, with so many members, it would be a very complicated matter to calculate the size of the members if all the above external loadings were considered together.

To obviate confusion and minimize the chances of mistakes each kind of loading is considered separately. This will give us a stress diagram for each loading, a simple addition of the forces from each diagram will enable us to arrive at the total stress from all causes in each member. It is obvious to all of us that all the four loadings could not operate at the same time—*i.e.*, it is beyond the bounds of probability that over a yard deep of snow would lie on the roof in a 100 miles per hour gale, yet the structure is designed to withstand this, such being the liberal allowances made in the whole of the structure. The method of constructing the stress diagrams is the usual one—*i.e.*, find the reactions by taking moments or by a graphic method. Having done so, we then know the *magnitude* and *direction* of all the external forces, and it is quite a simple matter to resolve them in the *direction* of the members of the truss.

In fact, each joint can have a separate resolution to itself. For example, a joint of three members would be resolved into a triangle of forces, the simplest form of stress diagram; a joint of four members would have a diagram of four lines. The only reason they are drawn all added together is because each joint is perforce connected to the next by the member between and when we have drawn the diagram of one joint we must necessarily have got all the information of at least one of the members of the neighbouring joint. This gives us a good start to resolve the next joint, as one line is already drawn, giving magnitude and direction of the force in that member.

Discussion.

The **President** (Mr. A. W. Attwood) said the merits of the waterless holder as compared with a water sealed one were debatable and were outside the scope of the Paper except so far as the relative strengths were concerned.

Mr. W. N. Smirles (Birmingham) proposed a vote of thanks to Mr. Tidball.

Mr. D. J. Ward (Birmingham), who seconded the vote of thanks, said, in his opinion, as an engineering feat, a waterless holder was marvellous. He thought that wind pressure did not affect the working of a construction like a waterless holder to anything like the extent that it did a water sealed holder, and this was a point in its favour.

Mr. S. C. Bentley (Leicester) asked Mr. Tidball several questions relating to the factors of safety mentioned in the Paper.

Mr. J. H. Gee (Birmingham) asked what was the factor of safety in the collapsible telescopic staircase which gave access to the piston. From its appearance it did not seem to be a particularly strong structure.

Mr. W. T. Hobson (Wolverhampton) said that he noticed this type of holder was polygonal, not round, and he thought that if the plates were curved they would be stronger and lend themselves better to the upward and downward movement of the piston. The height of the waterless type of holder always exceeded the diameter, whereas in a water sealed holder it was very seldom that the height was greater than the diameter. He considered Mr. Tidball had made out a good case for the stability of the structure as a whole. He noticed that in designing the holder, the wind pressure had been taken as 50 lb. per sq. ft. and the snow load 15·3 lb. per sq.ft., and the thought these figures were high for a holder in the Midlands. He was interested in the anchorage and the design of the foundation bolts. The overturning moment was greater in this type of holder than in other types, but the factor of safety was adequate.

Mr. F. Plant (Birmingham) asked what was the wind load on the leeward side of the holder.

Mr. F. A. Jenkins (Leamington) raised the question of vacuum on the lee side of the holder, stating that in some cases this was as great as the wind pressure on the windward side.

Mr. Tidball, in reply, thanked the members for the way they had received his Paper. It had been suggested that at ground level, in the vicinity of a waterless gasholder, a high wind always seemed to be blowing, and he was of opinion that this was due to the size of the holder which created eddies, and the suction effect would heighten the feeling that a high wind was blowing.

With regard to the bending moment, he thought if the holder were regarded as a prismatic whole, this was negligible.

As to the reversal of stress above and below the piston, he did not think this could be taken into consideration when calculating or considering wind pressures. The gas pressure was an internal one which operated in all directions, and, therefore, nullified itself as regards the overturning moment. The only thing which should be taken into consideration was the external force.

The application of wind pressure and suction on the lee side was a point upon which engineers and experts had fallen out on very many occasions.

The factor of safety of the collapsible staircase was as high as any other portion of the holder. He thought it was a matter of opinion as to whether straight or curved plates were the better; he certainly preferred straight sections himself.

Dealing with the question of the wind pressure and snow load used in the calculations for the roof principles, he said he was pleasantly surprised at the figures in the German calculations. M.A.N. took high factors for all their loadings, and consequently showed a very high factor of safety which gave increased confidence in the structure.

The factor of safety of the anchorage was a high one, but this was all to the good.

There were very few data to go on in regard to wind pressures on large surfaces, and he was of opinion that wind pressure on large structures had not the same effect as on small ones, but the question was a controversial one.

A.D.1939

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Cape Town and District Gas Light and Coke Company, Ltd.

The Forty-Ninth Ordinary General Meeting of the Cape Town Gas Light and Coke Company, Ltd., was held at the Company's Offices, Africa House, Kingsway, London, W.C. 2, on Friday, March 31, 1939—Sir GEORGE L. BARSTOW, K.C.B. (Chairman of Directors), presiding.

The MANAGING DIRECTOR AND SECRETARY (Mr. R. W. Blackburn) read the notice convening the meeting, together with the Auditors' report on the balance sheet. The Directors' Report and Statement of Accounts for the year ended Dec. 31, 1938, were taken as read.

THE CHAIRMAN'S ADDRESS.

The CHAIRMAN, in moving the adoption of the Report and Accounts, observed that the report dealt fairly fully with the most outstanding features of the year's working, and he had little to add to it. They had had, he regretted to say, another lean year. Their Revenue Account showed a reduction of nearly £3,000, of which about one-half was due to smaller returns from residuals, and this in turn was due to the smaller amount of coal carbonized. The volume of gas sold was lower by 1·43%.

Expenditure on Revenue Account was lower by about the same amount, £3,000, and they had felt justified in charging to Reserve for renewals the expenditure incurred on renewal of gasholders and boilers. Payments made during the year to retired employees had been charged against the Pensions Fund, which had been accumulated out of former profits as a nucleus for a contributory pensions scheme.

The balance carried to Net Revenue Account enabled them to meet the interest on Debentures and the premium on Sinking Fund Policy; but he was afraid it left no margin for dividends on Preference and Ordinary Shares. Disappointing as this was, the Chairman thought no blame attached to their staff in Cape Town who did their best in face of very keen competition from the Corporation's Electricity Department. Their Engineer informed him in a recent letter that they had tremendous competition with electricity, which was boosted in the local Press to the extent of from three to five full pages in both morning and evening papers at least twice a week, and the price at which current was available to domestic consumers was lower than in nearly every town in England. They could not complain of this, he supposed; it was the sort of thing that gas companies in competition with rate-supported undertakings had to put up with. He had previously expressed the opinion that the Municipal Authorities were misguided to lay such undue emphasis on electricity as distinct from gas and that the interests of Cape Town would be better served if gas were given a fairer chance. In this connexion, the Chairman read the following paragraph from the recent speech of the President of the South Metropolitan Gas Company:

> "We know that the strength of our Industry lies in the inherent merits of its processes and of the products that it offers. There is something else—the spirit of those who work in it. I have had more than forty years in the Industry, and every day my faith grows stronger that, heat for heat and convenience for convenience, gas is the most reliable, the most economic and, having regard to its labour saving, the cheapest of all fuels or forms of energy. In fact, I say without hesitation that the prestige of gas has never stood higher than it stands to-day. That is the reason, coupled with the spirit of its workers why I am confident of the future of our Industry."

The CHAIRMAN then formally moved:

> "That the Directors' Report and Statement of Accounts for the year ended Dec. 31, 1938, now presented, be and they are hereby adopted by this Meeting."

The resolution was seconded by Mr. EDWIN NICHOLLS.

Mr. D. T. LIVESEY questioned the policy of past years in building up a Reserve and Contingency Account of £74,000; he referred to the balance of capital account of £106,000 carried to the General Balance Sheet, criticized the high level at which production expenditure remained in relation to income, and suggested that it would be advisable for an expert gas engineer to be sent to Cape Town to investigate the working of the Company.

Mr. BLACKBURN said that the accounts of the Company had been presented, and approved in their present form for many years; the Company's Auditors or himself would be pleased to give any explanations in regard to the Capital Account and General Balance Sheet that Mr. Livesey might properly desire.

With regard to the question of production expenditure at Cape Town, this had been the subject of careful consideration; expert consultants in this country had made full investigation into the figures of the Company's working and the Company's Engineer and General Manager had been called home for consultation thereon.

Retrenchments Effected.

Retrenchments had been effected, but certain factors existed over which their officials had no control—for instance the rising costs of coal, wages, and materials. Logically such increase could, if thought advisable, as in the United Kingdom, be met by increasing the charges for gas, but unfortunately this course if followed at the present juncture would result in losing further gas business; they had to carry on under a handicap more severe than that encountered by any undertaking in this country competing as they did with a Municipal electric supply not compelled to earn profits. As the Chairman had pointed out on previous occasions, it did not appear equitable that electricity (and the sale of electrical appliances on easy terms) should be pushed municipally directly in competition with gas for domestic consumption at such a low rate (down to ½d. per unit) and that such an uneconomic procedure should be subsidized by the higher prices charged for current for lighting and for other purposes. To counter this the Company had lowered gas charges and provided increased facilities for gas service. They had also built up-to-date gas showrooms on their own site and reorganized their business under expert technical management with competent staffs.

In the last few years gas had put up a terrific fight in order to survive in the face of subsidized competition; this must necessarily entail heavy expenditure, and since 1933 profits had not been more than sufficient to provide for prior charges, with no margin available for the payment of dividends.

Mr. A. E. HAYES asked whether it was the object of the electric supply at Cape Town to squeeze the Company out of business altogether. He (Mr. Hayes) said that the Company was, he knew, well served by its staffs who had to work under difficult conditions. The expansion of demand on the industrial side at Cape Town was, he understood, very satisfactory indeed, and the fact that gas at all times was available and could be relied upon for continuity of supply and for regulated delivery to any extent as and when required must, he thought, be considered an asset to Cape Town in attracting to the City manufacturers considering industrial development there, particularly having regard to the fact that the establishment of industrial processes was being so much encouraged in the Union. It was therefore all the more astonishing that gas should receive no encouragement from the Authorities responsible for the development of the amenities of Cape Town. Would not an intensive "gas" drive enable the number of consumers to be increased?

The CHAIRMAN observed that he had no information of the intentions of the Electricity Authority, but he thought the facts spoke for themselves. A scheme to increase the number of consumers was at the present time under consideration, and their Engineer was formulating proposals to this end; he hoped the shareholders would take it from him that they were doing all they could to increase the consumption of gas in Cape Town, and he hoped that some measure of success would attend their efforts.

The Report and Accounts were unanimously adopted.

On the proposition of the CHAIRMAN, seconded by Mr. BLACKBURN, the retiring Director, Mr. Edwin Nicholls, was unanimously re-elected, Mr. NICHOLLS briefly acknowledging his re-election.

The Company's Auditors (Messrs. Kemp, Chatteris, Nicholls, Sendell, & Co.) were re-appointed at the same remuneration as heretofore, and the meeting closed with a vote of thanks to the Chairman, Directors, and staff on the proposition of Mr. LIVESEY, seconded by Mr. HAYES, to which the CHAIRMAN briefly responded.

Wilton

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1—High efficiency packing—maximum surface in minimum space.
(*Patent No.* 311249)

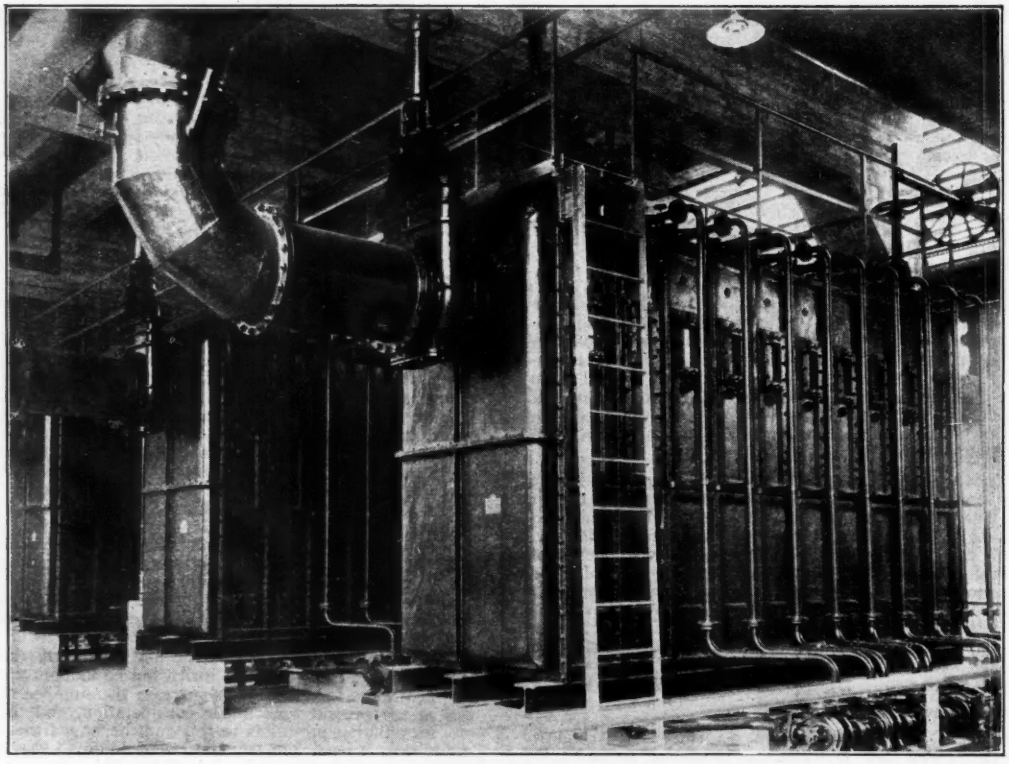
2—Progressive concentration from bay to bay without intermixing of washing media from one bay to next.

3—No stratification of washing media, special arrangements provided to ensure against this contingency.

4—Large cleaning doors provided to facilitate cleaning when necessary; also for removal of packing and cleaning and refitting in shortest possible time.

5—Patent self-cleaning sprays provided and inspection windows for same.
(*Patent No.* 292889)

6—Strongest possible concentration of products.



Three Wilton Patent Static Washers each 5 millions per diem capacity Extracting Ammonia from Coal-Gas

THE CHEMICAL ENGINEERING & WILTON'S PATENT FURNACE Co. LTD.
76, VICTORIA STREET, LONDON, S.W.1
Telegrams: "Evaporator, Phone, London." Telephone: Victoria 3126

Trade News

Thomas Potterton (Heating Engineers), Ltd.

As from April 15, Messrs. Thomas Potterton (Heating Engineers), Ltd., are removing to new premises at Cavendish Works, 20-30, Buckhold Road, Wandsworth, S.W. 18 (Phone: PUTney 2263-4-5), where all communications should be addressed on and after that date.

Ascot's 1939 Hot Water Campaign.

A broadsheet has been issued by Ascot Gas Water Heaters, Ltd., illustrating in advance the pictures and booklets which the firm have prepared for their hot water campaign. All the material described in the broadsheet is available, free of charge, to gas undertakings.

The 1939 campaign is based on the well-known range of "Ascot" appliances, comprising the "Ascot" sink water heater (Type R.12/4), the "Ascot" bath heater (Type SG.32), using the sink heater as a "spearhead." The following publicity material is offered: Stuffer (or Folder), 8-page booklet, crossword competition form, reply-paid postcard, double-crown poster, 16-sheet poster, three-unit window display, and blocks for Press advertising. Details of size, colour, and general contents of each item are given beside the respective illustrations in the folder, together with an indication of the space available for overprinting.

All literature can be overprinted with the name and address of the undertaking together with details of terms of purchase. Experience of the publicity value of similar overprinting in the past has proved conclusively the advantage of indicating boldly in pence (or fractions of pence) the easiest terms per day, and showing less prominently other methods of purchase.

An innovation this year is the inclusion of a free crossword competition, using clues linking up with the subjects gas, "Ascot," and hot water. Details for the easy solution will be readily found by the public on perusing the advertising matter mailed to them. "Ascot" sink heaters for the prize-winners will be offered free of charge to those undertakings running the competition, who will co-operate by installing the heaters at their own expense. In addition, a limited number of gramophone records of the song from the "Ascot" film, "Happy in the Morning," featuring Henry Hall and his band, will be available as consolation prizes for undertakings where the competition meets with the greatest response. This novel and inexpensive competition will afford an excellent opportunity of creating interest in the product, compelling readers to study the literature, enabling a check to be made on the response to the advertising, and compiling a most valuable list of names and addresses of potential sales contacts.

The individual items constituting the scheme as outlined above have been based on a single advertising theme to form a forceful and coherent campaign, designed for use in its entirety. This does not, however, preclude the use of separate items as required.

Gas Undertakings' Results

Haywards Heath.

The annual report of the Directors of the Haywards Heath District Gas Company states that the business of the Company continues to show satisfactory expansion. The Directors recommend a final dividend at the rate of 10% on the 5% consolidated stock for the half-year to Dec. 31, 1938, making 9%, less income-tax, for the year. This absorbs a sum of £1,834, leaving a balance of £4,910 to be carried forward. The sale of gas shows a satisfactory increase of £1,083, equal to 4·17% over 1937. Some 230 new consumers have been added, making the total 4,850, an increase of approximately 5%. Ten additional street lamps were added by the Council during the year, bringing the total public gas lamps in the Company's area of supply up to 372.

Jersey.

The report of the Directors of the Jersey Gas Light Company, Ltd., for the year 1938 is a satisfactory one. A further record has been created in the demand for gas; sales having increased by 2·1%, to 330 million cu.ft. The number of consumers continues to increase, 447 having been added during the year. The demand for gas-consuming apparatus has again exceeded all previous records—a total of 1,497 new appliances having been sold during 1938. Yet another gratifying feature is an increase of 36 in the number of public lamps—to 1,028. A dividend of 9% for the year on the ordinary shares will leave a balance of £7,354 to be carried to the next account. The profit on the year's working is £8,731, which compares with a profit of £7,718 for 1937, when the dividend was the same, and the carry forward was £7,748. The carry forward this year is after the transfer to reserve of £1,470, as against £1,250 a year ago.

SAWER & PURVES

(BRANCH OF METERS LTD.)

Sole Makers of "THE MODEL COIN COLLECTOR"

Ask for Particulars

It will be a pleasure to supply them

Painted and lettered as required

Excellent Finish

TELEPHONE
Manchester 2289
Collyhurst
Nottingham 75202
Watford 2645

TELEGRAMS
Sawer, Manchester
Sawer—
75202, Nottingham
2645, Watford

Derby Road
Watford

ESTABLISHED 1869.

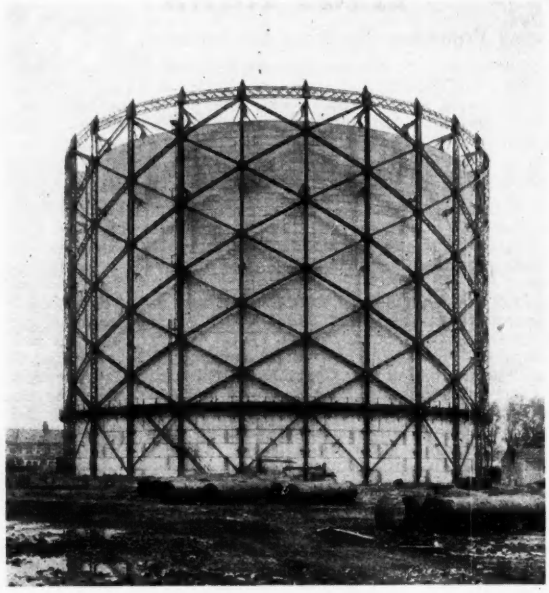
NELSON METER WORKS, MILES PLATTING, MANCHESTER, 10

Radford Meter Works
Radford Road
Nottingham

GASHOLDERS

GUIDE FRAMED
SPIRAL
WATERLESS
INSPECTION & REPAIRS

GASWORKS PLANT AND STRUCTURAL STEELWORK

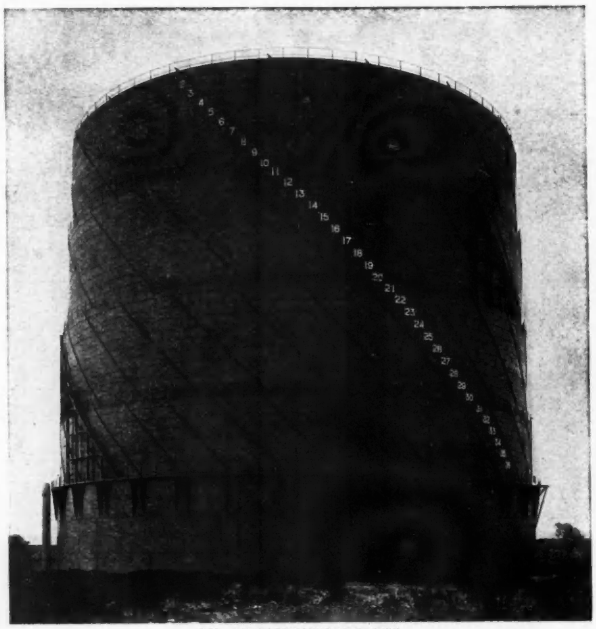


SAML. CUTLER & SONS, LTD.

39, VICTORIA STREET, LONDON, S.W. 1.
Telephone: ABBEY 3121 Telegrams: RETORTUS, SOWEST, LONDON

Telephone: EAST 5231 Providence Iron Works, Millwall, London, E.14. Telegrams: CUTLER, MILLWALL, LONDON

467



AT WOLVERHAMPTON
CAPACITY, 3 MILLION CUBIC FEET

C. & W. WALKER

LIMITED
DONNINGTON
Nr. WELLINGTON
—SHROPSHIRE

'Phone: Lilleshall-Shropshire Nos. 34 & 35 (2 lines)
'Grams: "Fortress," Donnington, Shropshire

SPIRAL GASHOLDERS

RIVETED OR ELECTRICALLY WELDED

BRITISH MATERIALS
BRITISH LABOUR
HIGHEST QUALITY
IN WORKMANSHIP

70 YEARS' EXPERIENCE

MILBOURNE SELF-LUBRICATING ROLLER CARRIAGES

LONDON OFFICE — 70, VICTORIA STREET, WESTMINSTER, S.W.1
'Phone: Victoria No. 1941 'Grams: "Fortress," Sowest, London

Markets and Manufactures

Current Sales of Gas Products

The London Market

April 8.

Prices of Tar Products show no change as compared with a week ago.

Pitch is nominal at about 27s. 6d. per ton f.o.b.

Creosote is about 3½d. to 3¾d.

Refined tar, 3¾d.

Pure toluole about 2s. 3d. to 2s. 4d.

Pure benzole, about 1s. 9d.

95/160 solvent naphtha, 1s. 7d. to 1s. 8d.

90/160 pyridine, about 10s.

All per gallon naked at makers' works.

The Provinces

April 8.

Crude Gas-Works Tar, 12s. to 17s.

To avoid misunderstanding, it is necessary to state that the above price is not claimed to represent a market value. It is a price worked out from week to week upon a system which has been used for many years as a basis for the fixing of certain contracts for crude tar of varying qualities in different areas.

The average prices of gas-works products during the week were: Pitch—East Coast, 29s. to 30s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 29s. to 30s.* Toluole, naked, North, 1s. 7½d. to 1s. 9d. Coal tar, crude naphtha, in bulk, North 7¾d. to 8¼d. Solvent naphtha, naked, North, 1s. 4½d. to 1s. 5d. Heavy naphtha, North, 1s. 2½d. to 1s. 3d. Creosote, *ex* works, in bulk, North, liquid and salty, 3⅞d. to 4⅛d.; low gravity, 4d. to 4¼d. Carbolic acid, 60's, 1s. 7d. to 1s. 10d. Naphthalene, £13 10s. to £16. Salts, 70s. to 75s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal; "B" quality unsaleable. Heavy oil: Unfiltered anthracene oil, min. gr. 1,080, 4¾d. to 4⅞d; filtered anthracene oil, min. gr. 1,080, 5¼d. to 5½d.; heavy tar oil, gr. less than 1,080, 4½d. to 4¾d.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls, whatever they may be.

Scotland

GLASGOW, *April* 7.

While new business is decidedly scarce, makers' prices are substantially the same.

Crude gas-works tar.—The actual value is round 30s. to 32s. per ton *ex* works in bulk.

Pitch of vertical quality can be secured at 20s. to 21s. per ton f.o.b. for export and round 20s. per ton *ex* works in bulk for home trade.

Refined tar.—Controlled prices rule in the home market at 3½d. to 4d. per gallon. Export supplies are offered freely at about 2¾d. to 3d. per gallon, both into buyers' packages at makers' works.

Creosote oil.—The largest consumers being well covered on contract, business is confined to comparatively small quantities. Prices are as follows: Specification oil, 3½d. to 3¾d. per gallon; low gravity, 4¼d. to 4½d. per gallon; neutral oil, 3¾d. to 4d. per gallon; all *ex* works in bulk.

Cresylic acid.—In the absence of demand of any consequence quotations are nominal as follows: Pale, 97/99%, 1s. 2d. to 1s. 3d. per gallon; dark, 97/99%, 1s. to 1s. 1d. per gallon; pale, 99/100%, 1s. 4d. to 1s. 7d. per gallon; all *ex* works in buyers' packages.

Crude naphtha is valued at 5½d. to 6d. per gallon *ex* works in bulk, according to quality.

Solvent naphtha.—90/160 grade can be secured at 1s. 3½d. to 1s. 4d. per gallon and 90/190 heavy naphtha at about 1s. 1d. to 1s. 1½d. per gallon.

Motor benzole is 1s. 3d. to 1s. 4d. per gallon.

Pyridine.—90/160 grade is 8s. 6d. to 9s. 6d. per gallon and 90/140 grade is 9s. 6d. to 10s. 6d. per gallon.

Benzole Prices

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole..	0 9½	to	0 10	per gall. at works
Motor ,, ..	1 3	,,	1 3½	,, ,, ,,
90% ,, ..	1 4	,,	1 4½	,, ,, ,,
Pure ,, ..	1 8	,	1 8½	, , ,

Contracts Advertised To-Day

Coal.

Birkenhead Gas Department. [p. 118.]

Malvern Gas Department. [p. 118.]

Gasholder.

Southport Gas Department. [p. 118.]

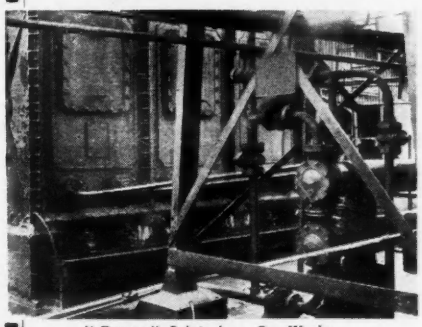
Minehead Gas Light and Coke Company, Ltd.

The quantity of gas sold last year by the Minehead Gas Light and Coke Company, Ltd., was practically the same as in the preceding twelve months; the figures being 288,268 therms in 1938, as compared with 289,249 therms in 1937—a decrease of 981 therms, or 0·3%. The sales of apparatus continue to be very satisfactory, and the number of consumers again shows an increase. The balance of net profit for the year is £4,184, as against £4,518 a year ago, and after the payment, as before, of a dividend of 8% on the original ordinary shares, there will be a balance to carry forward of £1,287, which compares with the sum of £1,386 brought in.

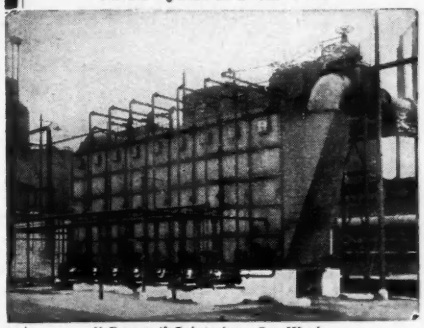
There's only one

Permac!

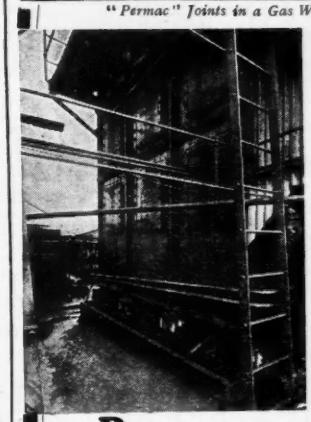
METAL-TO-METAL JOINTING MATERIAL



"Permac" Joints in a Gas Works



"Permac" Joints in a Gas Works.



"Permac" Joints in a Gas Works.

Be sure you get it!

Here is a selection of "Permac" joints photographed in various Gas Works. "Permac," the Metal-to-Metal Jointing, has been holding up difficult joints like these for over 25 years. Send for particulars.

Sole Manufacturers:

THOMAS & BISHOP LTD

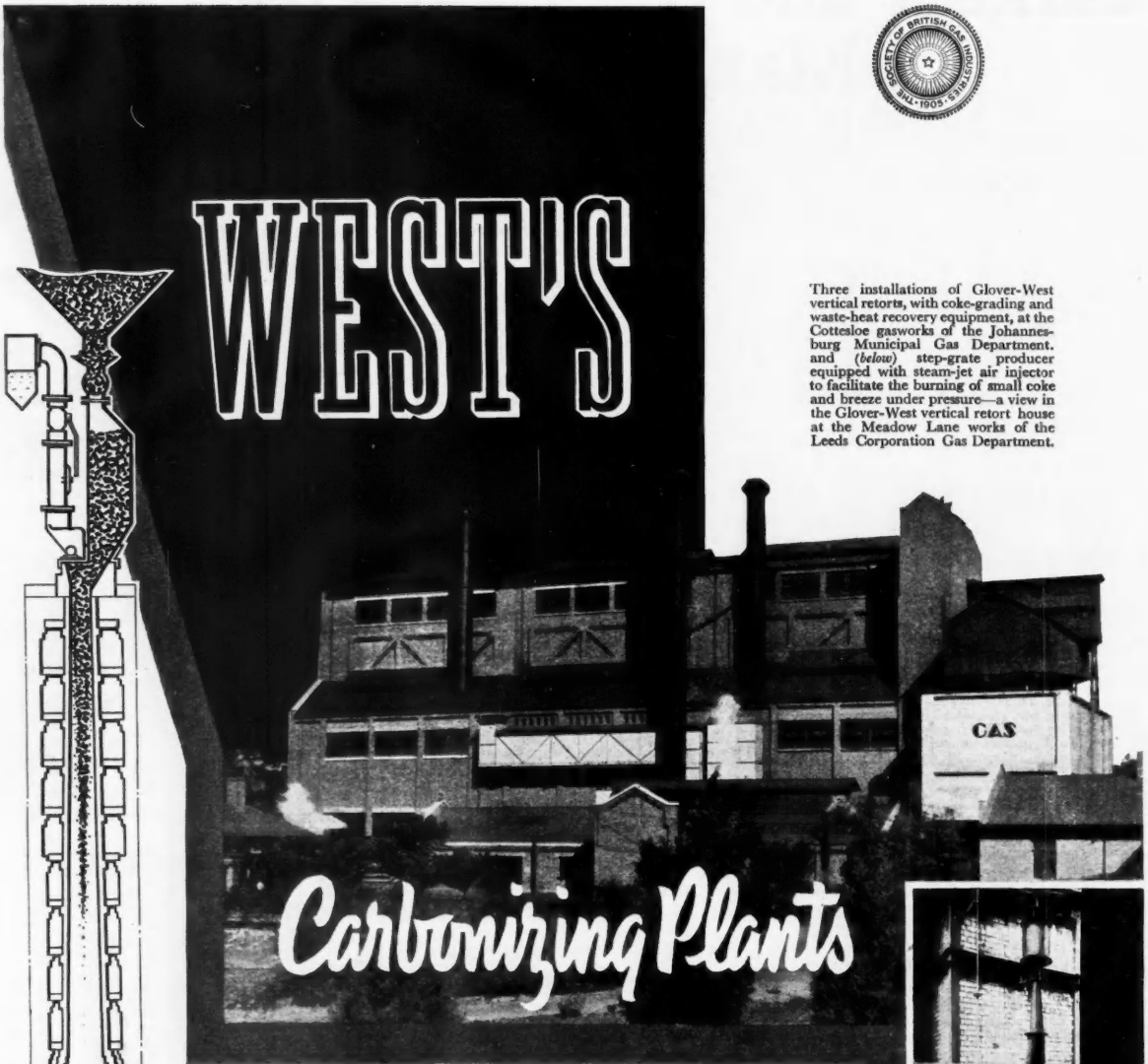
37, Tabernacle St.

LONDON, E.C. 2

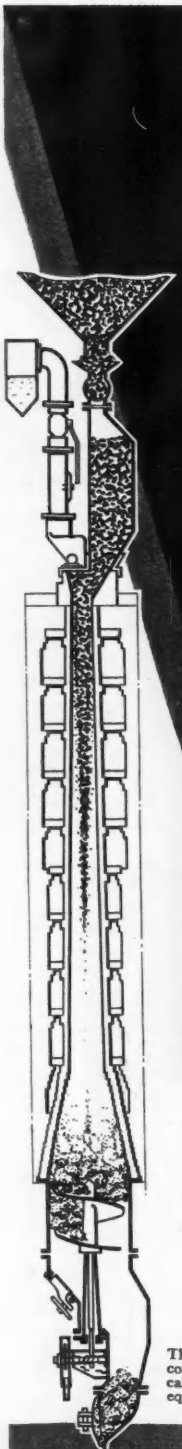
Telephone: Clerkenwell 3351 (2 lines)

WEST'S

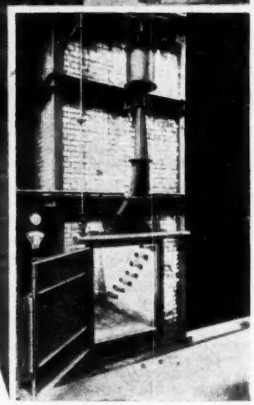
Three installations of Glover-West vertical retorts, with coke-grading and waste-heat recovery equipment, at the Cottesloe gasworks of the Johannesburg Municipal Gas Department. and *(below)* step-grate producer equipped with steam-jet air injector to facilitate the burning of small coke and breeze under pressure—a view in the Glover-West vertical retort house at the Meadow Lane works of the Leeds Corporation Gas Department.



Carbonizing Plants



The Glover-West continuous vertical retort and equipment.



- Increased capacity in relation to ground area covered.
- Output readily adjustable to meet fluctuating demands.
- High yields of gas and coke with low maintenance costs.
- Clean working conditions within the retort house.
- Modern building design and smokeless operation.

WEST'S GAS IMPROVEMENT COMPANY, LTD.
MILES PLATTING, MANCHESTER 10 & COLUMBIA HOUSE, ALDWYCH, W.C.2

Glover-West Vertical Retorts
AND WESTVERTICAL CARBONIZING CHAMBERS

434 PLANTS BUILT OR ORDERED IN 24 COUNTRIES

GAS STOCKS AND SHARES

International affairs—now a *sine qua non*—once more dominated business on the Stock Exchange last week and the volume was again very small. The best that can be said for it is that there has been no selling pressure. Gilt-edged stocks kept fairly steady, and there was little change in home rails despite an improvement in the latest traffic returns. Business in industrials was confined mostly to a few specialities and price movements generally were of a minor character. The more speculative sections such as oils, rubbers, and mines were more or less neglected, operators awaiting more settled conditions. Markets will doubtless be further depressed during the current week by reason of the latest international crisis.

The Gas market was fairly well supported and prices on the whole remained steady. The demand for Gas Light units was such that the price closed 3d. up on the week at 20s. 6d. This was the only appreciation, however, though apart from ex div. markings the reactions among "ordinaries" was confined to the Commercial with a drop of 2 to 55 and South Suburban which fell a point to 109½. It will be seen in the List below that several debenture stocks also reacted a point or two.

The Sheffield and District Gas Company last week placed privately at 100¾ net £500,000 4% debenture stock redeemable on July 15, 1964, at par, or at the option of the Company as a whole on July 15, 1959, on three months' notice. The proceeds of the issue are for repayment of mortgages amounting to £485,000 bearing interest at 7½%, thus securing a large saving in interest charges, and to provide further capital.

The net profit of the Primitiva Gas Company of Buenos Aires (whose shares are now held almost entirely by Primitiva Holdings and by an associated company of Cia Hispano-Americana de Electricidad) for 1938 was £4,245 up on 1937 at £190,271. The dividend is unchanged at 2¼%, tax free, and after allowing for this and transfers to various reserves the carry-forward is £77,634 against £74,851.

Official Quotations on the London Stock Exchange

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations April 6.	Rise or Fall on Week.
1,767,439	Mar. 6	8	8	Alliance & Dublin Ord. ...	130—140	...
374,000	Dec. 19	4	4	Do. 4 p.c. Deb. ...	93—98	...
734,733	Nov. 7	5	5	Ascd. Gas & Water U'd'ts Ord.	17/—19/—	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/—21/—	...
444,389	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	19/—21/—	...
296,523	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	16/—18/—	...
500,000	Mar. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	92—97	...
560,070	Feb. 20	7	7	Barnet Ord. 7 p.c.	155—160	...
300,000	Apl. 6	1/4†	1/9§	Bombay, Ltd.	19/6—21/6*	—1/—
181,185	Feb. 20	9½	9½	Bournemouth sliding scale ...	192—202	...
690,526	,,	7	7	Do. 7 p.c. max. ...	155—160	...
493,960	,,	6	6	Do. 6 p.c. Pref. ...	128—133	...
50,000	Dec. 19	3	3	Do. 3 p.c. Deb. ...	73—78	—2
362,025	,,	4	4	Do. 4 p.c. Deb. ...	95—100	...
335,000	,,	5	5	Do. 5 p.c. Deb. ...	113—118	...
357,900	Feb. 20	7½	7½	Brighton, &c., 6 p.c. Con. ...	141—146	...
659,955	,,	6½	6½	Do. 5 p.c. Con. ...	124—129	...
205,500	,,	6	6	Do. 6 p.c. 'B' Pref.	123—128	...
855,000	Mar. 20	7	8	British Ord.	128—133	...
100,000	Dec. 19	7	7	Do. 7 p.c. Pref.	138—143	...
350,000	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	112—117	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb. ...	†4—99	...
450,000	,,	5	5	Do. 5 p.c. Red. Deb. ...	100—105	...
450,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
100,000	22 May '33	6	4	Cape Town, Ltd.	1—2	...
100,000	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—2	...
150,000	Dec. 19	4½	4½	Do. 4½ p.c. Deb. ...	60—70	...
626,860	Feb. 6	6	6	Cardiff Con. Ord.	115—120	...
237,860	Dec. 19	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...
98,936	Mar. 20	2/—	2/—	Colombo Ord.	1⅞—1½	...
24,510	,,	1/4†	1/4†	Do. 7 p.c. Pref. ...	22/—24/—	...
739,453	Mar. 20	—/11-48	—/11-48	Colonial Gas Assn. Ltd. Ord.	16/—18/—	...
296,144	,,	1/3·30	1/3·30	Do. 8 p.c. Pref. ...	23/—25/—	...
1,775,005	Jan. 23	5	4	Commercial Ord.	50—60	—2
140,000	Feb. 6	§13/4	4	Do. 4 p.c. Red. Pref. ...	95—100	...
620,000	Dec. 5	3	3	Do. 3 p.c. Deb. ...	62—67	...
286,344	Feb. 20	5	5	Do. 5 p.c. Deb. ...	108—113	...
200,000	,,	5½	4	Do. 3½ p.c. Red. Deb. ...	95—100	...
807,560	Feb. 20	7	7	Croydon sliding scale ...	127—132	...
644,590	,,	5	5	Do. max. div.	95—100	...
620,385	Dec. 19	5	5	Do. 5 p.c. Deb. ...	110—115	—2
239,000	Feb. 6	5	5	East Hull Ord. 5 p.c.	93—98	...
187,215	Feb. 6	6	6	East Surrey Ord. 5 p.c. ...	113—118	...
176,211	Dec. 5	5	5	Do. 5 p.c. Deb ...	110—115	...
250,000	Nov. 7	8	4	Gas Consolidation Ord. 'B' ...	19/—21/—	...
250,000	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	17/6—19/6	...
19,189,963	Feb. 6	5§	5§	Gas Light & Coke Ord. ...	20/—21/—a	+—/3
2,600,000	,,	3½	3½	Do. 3½ p.c. max. ...	71—74	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	93—97	...
2,993,000	Jan. 9	3§	3§	Do. 3§ p.c. Red. Pref. ...	95—98	...
8,602,497	Nov. 21	3	3	Do. 3 p.c. Con. Deb. ...	71—76	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	107—111	—1
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	105—109	...
700,000	Mar. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	93—96	...
270,466	Feb. 20	6	6	Harrogate New Cons. ...	115—120	...
157,500	Mar. 20	‡1/—	‡1/—	Hong Kong and China Ord. ...	⅝—¾	...
213,200	Feb. 6	5§	6	Hornsey Con. 3½ p.c. ...	97—102	...
5,600,000	Oct. 24	12	8	Imperial Continental Cap. ...	113—118	...
172,810	Jan. 23	3½	3½	Do. 3½ p.c. Red. Deb. ...	88—93	...
235,242	Mar. 6	8½	8½	Lea Bridge 5 p.c. Ord. ...	148—158	...
63,480	Dec. 19	3	3	Maidstone 3 p.c. Deb. ...	68—73	...
45,000	Nov. 21	†10	†10	Malta & Mediterranean Metropolitan (of Melbourne)	130—135	...
392,000	Apl. 6	5½	5½	5½ p.c. Red. Deb.	98—103*	—2
231,977	Feb. 20	5	5	M.S. Utility 'C' Cons. ...	96—101	...
968,658	,,	4	4	Do. 4 p.c. Cons. Pref. ...	90—95	...
390,076	Dec. 19	4	4	M.S. Utility 4 p.c. Deb. ...	92—97	...
148,955	,,	5	5	Do. 5 p.c. Deb. ...	110—115	...
125,000	Jan. 3	3½	3½	Do. 3½ p.c. Red. Bds.	94—97	...
675,000	Nov. 21	†6	†6	Montevideo, Ltd.	7C—75	...
250,000	Mar. 6	7½	7½	North Middlesex 6 p.c. Con.	140—145	...
396,160	Feb. 6	5	5	Northampton 5 p.c. max. ...	105—110	...
300,000	Oct. 24	†7	†9	Oriental, Ltd.	145—150	...
468,537	Dec. 5	8	7½	Plymouth & Stonehouse 5 p.c.	130—140	...
621,667	Feb. 20	8½	8½	Portsmouth & Gosport Cons.	154—159	...
241,446	,,	5	5	Do. 5 p.c. max. ...	98—103	...
73,350	,,	5	5	Do. 5 p.c. Pref. ...	103—108	...
75,000	,,	4	4	Do. 4 p.c. Pref. ...	88—93	...
114,000	Feb. 6	5	5	Preston 5 p.c. Pref.	105—110	...
247,966	Dec. 19	4	4	Primitiva 4 p.c. Cons. Deb. ...	96—101	...
625,959	Jan. 9	4	4	Do. 4 p.c. Red. Deb. ...	94—99	...
15,000	Mar. 6	6	6	San Paulo 6 p.c. Cum. Pref. ...	8—9	...
441,275	Sept. 19	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	20/6—22/6	...
460,810	Mar. 20	—/10§	—/10§	,, ,, 4½ p.c. Cum. Pref.	19/—21/—	...
133,201	Mar. 6	8½	5	Shrewsbury 5 p.c. Ord. ...	141—146	...
9,000	June 3	4	‡4	South African Ord.	4½—5½	...
1,371,752	Aug. 22	1/2§	1/2§	South East'n Gas Cn. Ld. Ord.	21/6—23/6	...
871,636	Mar. 6	—/10§	—/10§	Do. 4½ p.c. Red. Cum. Pref.	19/—21/—	...
498,818	,,	4	4	Do. 4 p.c. Cum. Pref. ...	17/—19/—	...
450,000	Feb. 6	4	4	Do. 4 p.c. Deb.	96—101	...
150,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	93—98	...
6,709,895	Feb. 6	5	6	South Met. Ord.	94—98	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	123—128	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	90—95	...
1,895,445	Dec. 19	3	3	Do. 3 p.c. Deb.	71—76	...
1,000,000	Jan. 9	5	5	Do. 5 p.c. Red. Deb. ...	105—109	—1§
600,000	,,	§31/—	3§	Do. 3§ p.c. Red. Deb. ...	98—101	...
1,543,795	Jan. 23	6	6	South Suburban Ord. 5 p.c. ...	107—112	—1
512,825	,,	5	5	Do. 5 p.c. Pref.	103—108	...
500,000	,,	4	4	Do. 4 p.c. Pref.	90—95	...
250,000	,,	3§	3§	Do. 3§ p.c. Red. Pref. ...	91—96	...
888,587	Dec. 5	5	5	Do. 5 p.c. Deb.	109—114	—1
250,000	,,	4	4	Do. 4 p.c. Deb.	93—98	...
200,000	Feb. 6	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
427,859	Apl. 6	9§	1/2§	S. Western Gas & Water Ord.	15/6—17/6*	—/6
160,523	Apl. 6	—/10§	—/10§	Do. 4½ p.c. Red. Cum. Pf.	18/6—20/6*	—/6
110,000	Dec. 19	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...
750,541	Feb. 6	5	5½	Southampton Ord. 5 p.c. ...	104—109	...
148,836	Dec. 19	4	4	Do. 4 p.c. Deb.	93—98	...
350,000	Feb. 6	5½	5½	Swansea 5½ p.c. Red. Pref. ...	105—110	...
200,000	Dec. 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	92—97	...
1,076,490	Feb. 20	6§	6§	Tottenham and District Ord.	120—125	...
409,835	,,	5§	5§	Do. 5½ p.c. Pref.	113—118	...
62,235	,,	5	5	Do. 5 p.c. Pref.	103—108	...
453,380	Dec. 5	4	4	Do. 4 p.c. Deb.	90—95	...
85,701	Jan. 9	6	6	Tuscan 6 p.c. Red. Deb. ...	95—100	...
1,131,550	Aug. 22	6	4	U. Kingdom Gas Cor. Ord. ...	18/—19/—	...
1,051,280	Nov. 7	4§	4§	Do. 4½ p.c. 1st Cum. Pref.	19/—21/—	...
762,241	,,	4	4	Do. 4 p.c. 1st Red. Cum. Pf.	19/—21/—	...
745,263	Dec. 19	4§	4§	Do. 4½ p.c. 2nd Non-Cum. Pf.	15/6—17/6	...
1,066,186	Mar. 6	3§	3§	Do. 3½ p.c. Red. Deb. ...	95—98	—1
378,106	Mar. 6	7	7	Uxbridge, &c., 5 p.c.	122—127	...
133,010	,,	5	5	Do. 5 p.c. Pref. ...	102—107	...
1,371,138	Jan. 23	7	7	Wandsworth Consolidated ...	120—125	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	89—94	...
1,343,964	Dec. 19	5	5	Do. 5 p.c. Deb. ...	109—114	—1
383,745	,,	4	4	Do. 4 p.c. Deb. ...	92—97	...
400,000	,,	§25/—	3§	Do. 3§ p.c. Red. Deb. ...	96—101	...
558,342	Feb. 6	6§	6§	Watford and St. Albans Ord.	127—132	...
200,000	,,	5	5	Do. 5 p.c. Pref. ...	103—108	...
200,000	,,	5§	5§	Do. 5§ p.c. Pref. ...	110—115	...
200,000	,,	§16/8	4	Do. 4 p.c. Red. Pref. ...	95—100	...
200,000	Dec. 19	4	4	Do. 4 p.c. Red. Deb. ...	93—98	...
200,000	,,	3§	3§	Do. 3§ p.c. Red. Deb. ...	92—97	...

a.—The quotation is per £1 of stock. * Ex. div. † Paid free of income-tax. ‡ For year. § Actual.

Supplementary List and Provincial Exchanges overleaf.

STOCK AND SHARE LIST—Cont.

Supplementary List, not Officially Quoted, London

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Nominal Quotations April 6.	Rise or Fall on Week.
202,152	Mar. 20	5	5	Ascot Ord.	99—104	...
128,182	Dec. 19	5	5	Do. 5 p.c. Pref.	102—107	...
31,035	Mar. 20	–/4†	–/4†	Associated Utilities 4 p.c. Pref.	15/—17/–	...
100,000	Dec. 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...
17,000	Feb. 20	8	8	Bognor Orig. Ord. 'A' ...	152—162	...
62,210	,,	8	8	Do. New Addl. 'A' ...	152—162	...
87,160	,,	7	7	Do. New 7 p.c. max. ...	142—152	...
37,440	Feb. 6	10	10	Cam. Univ. & Town 10 p.c. max.	183—193	...
125,970	,,	7	7	Do. 7 p.c. max.	131—136	...
39,025	,,	5	5	Do. 5 p.c. max.	95—100	...
96,410	Feb. 6	4½	4½	Cardiff 4½ p.c. Pref.	93—98	...
150,000	Feb. 20	4	4	Croydon 4 p.c. Pref.	91—96	...
130 000	Dec. 19	4	4	Do. 4 p.c. Deb.	93—98	...
65,000	Mar. 6	7½	7½	Eastbourne 'A' 5 p.c. ...	122—132	–3½
198,000	,,	6	6½	Do. 'B' 3½ p.c.	105—115	–3½
112,312	,,	5	5	Do. 5 p.c. Pref.	102—107	...
130,000	Dec. 19	5	5	Do. 5 p.c. Deb.	108—113	...
24,000	Feb. 20	8½	8½	Great Yarmouth 8½ p.c. max.	30—35	...
59,400	,,	7½	7½	Do 7½ p.c. max.	27—32	...
51,160	Dec. 5	5½	5½	Do. 5½ p.c. Deb.	117—122	...
152,600	Feb. 20	8	9	Guildford Cons.	160—165	...
54,055	,,	5	5	Do. 5 p.c. Pref.	102—107	...
68,250	Dec. 19	5	5	Do. 5 p.c. Deb.	109—114	...
156,600	Feb. 20	7½	7½	Hampton Court Cons. ...	120—125	...
80,000	Mar. 6	4	4	Lea Bridge 4 p.c. Pref. ...	90—95	...
60,000	,,	6	6	Do. 6 p.c. Pref.	120—125	...
94,876	Dec. 5	4	4	Do. 4 p.c. Deb.	90—95	...
73,620	Mar. 6	8½	8½	Luton Cons. 'A'	150—160	...
107,960	Mar. 20	4	5½	Mid Kent Ord.	8½—9½	...
230,940	Feb. 6	10	10	Oxford & District Ord. ...	192—197	...
47,112	,,	5	5	Do. 5 p.c. Pref.	102—107	...
50,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	108—113	...
126,193	Nov. 7	7½	7½	Peterborough Ord.	137—142	...
64,990	Mar. 6	7½	7½	Redditch Ord.	115—125	...
166,850	Feb. 6	8	8	Romford Ord.	137—142	–5
60,000	,,	4	4	Do. 4 p.c. Pref.	97—102	...
44,000	Mar. 20	5	5	Do. 5 p.c. Deb.	108—113	...
25,570	Feb. 6	5½	5½	Rugby 5½ p.c. Pref.	118—123	...
25,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	103—108	...
42,750	Dec. 5	5½	5½	Do. 5½ p.c. Deb.	117—122	...
110,950	Feb. 20	8	8	Ryde Ord.	137—147	...
270,086	Mar. 20	7	7	Slough Ord.	126—131	...
21,000	Dec. 19	5	5	Do. 5 p.c. Deb.	107—112	...
28,872	Nov. 7	5½	5½	S. Midland Gas Cpn. Ltd. Ord.	17/—19/–	...
28,866	Mar. 6	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	17/—19/–	...
117,228	Feb. 20	5	7	Swindon Cons.	100—105	...
60,425	Dec. 5	5	5	Do. 5 p.c. Deb.	108—113	...
64,380	Dec. 19	5	5	Torquay & Paignton 5 p.c. Pref.	105—110	...
130,000	Feb. 6	5	8	Wakefield Ord.	116—121	...
81,650	,,	5	5	Do. 5 p.c. max.	92—97	...
82,000	Jan. 23	6	6	Weymouth Ord.	101—106	...
98,384	Feb. 6	6	6	Wolverhampton 6 p.c. Pref.	115—120	...
160,000	Dec. 19	5½	5½	Do. 5½ p.c. Rd. Db.	103—108	...
90,000	Dec. 19	5	5	York 5 p.c. Red. Deb. ...	102—107	...
133,640	Feb. 20	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	115—120	...
120,000	,,	5	5	Do. 5 p.c. Pref.	102—107	...
35,000	Dec. 5	5½	5½	Do. 5½ p.c. Deb.	112—117	...

BRISTOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 31.	Rise or Fall on Week.
347,756	Feb. 6	5	6	Bath Cons.	115—117	...
1,667,250	Feb. 6	5	5	Bristol, 5 p.c. max.	106—109	...
120,420	Dec. 19	4	4	Do. 1st 4 p.c. Deb. ...	98—101	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	98—101	...
328,790	,,	5	5	Do. 5 p.c. Deb.	115—118	...
274,000	Feb. 20	5	5	Newport (Mon.) 5 p.c. max. ...	95—97	...
13,200	Mar. 20	7	8½	Pontyp'l Gas & W. 10 p.c. 'A'	12½—13½*	...
13,600	,,	6	5	Do. 7 p.c. 'B' ...	11½—12*	...
40,000	,,	6	5	Do. 7 p.c. 'C' ...	11½—12*	...
140,778	Feb. 6	5	5	Weston-super-Mare Cons. ...	103½—105½	...
64,338	Dec. 19	4	4	Do. 4 p.c. Deb. ...	98—101	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb. ...	149—152	...

LIVERPOOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 31.	Rise or Fall on Week.
157,150	Feb. 6	5	6½	Chester 5 p.c. Ord.	107—110	...
92,500	Dec. 19	4	4	Do. 4 p.c. Pref.	95—99	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	87—90	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb ...	97—101	...
2,167,410	Feb. 20	6	6	Liverpool 5 p.c. Ord.	120—122	...
245,500	Dec. 19	5	5	Do. 5 p.c. Red. Pref. ...	100—105	...
306,083	Jan. 23	4	4	Do. 4 p.c. Deb.	100—102	...
106,280	Feb. 6	10	10	Preston 'A' 10 p.c.	177—187	...
188,219	,,	7	7	Do. 'B' 7 p.c.	129—139	...

NEWCASTLE EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 31.	Rise or Fall on Week.
122,577	Feb. 20	8	8	Blyth 5 p.c. Ord.	157½—158½	...
732,000	Feb. 20	3	3	Hartlepool G. & W. Cn. & New	67½—68½	...
2,061,315	Feb. 6	5	5½	Newcastle & Gateshead Con.	22/6–23/–σ	...
682,856	,,	4	4	Do. 4 p.c. Pref. ...	99—101	...
776,706	Dec. 19	3½	3½	Do. 3½ p.c. Deb. ...	88—89	...
277,285	Oct. 24	5	5	Do. 5 p.c. Deb. '43 ...	103½—105½	...
332,351	Feb. 6	6	6	Sunderland 6 p.c. max. ...	132½—134½	...

NOTTINGHAM EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 31.	Rise or Fall on Week.
542,270	Feb. 6	6	9	Derby Con.	132—137	...
55,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—105	...
20,000	Dec. 19	5	5	Long Eaton 5 p.c. Pref. ...	10—12	...
80,000	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...

SHEFFIELD EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 31.	Rise or Fall on Week.
10,000	Feb. 6	10	10	Great Grimsby 'A' Ord. ...	180—190	...
6,500	,,	10	10	Do. 'B' Ord. ...	180—190	...
79,000	,,	10	10	Do. 'C' Ord. ...	175—185	...
1,806,339	Feb. 20	6½	6½	Sheffield Cons.	135½—137½	...
95,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—102	...

σ The quotation is per £1 of Stock.
* Ex div.

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